Noah Krill
Data Structures
20 April 2020

1. 8, 7, 17, 4, 15, 9, 1.

   7, 8, 17, 4, 15, 9, 1

   7, 8, 17, 4, 15, 9, 1

   4, 7, 8, 17, 15, 9, 1

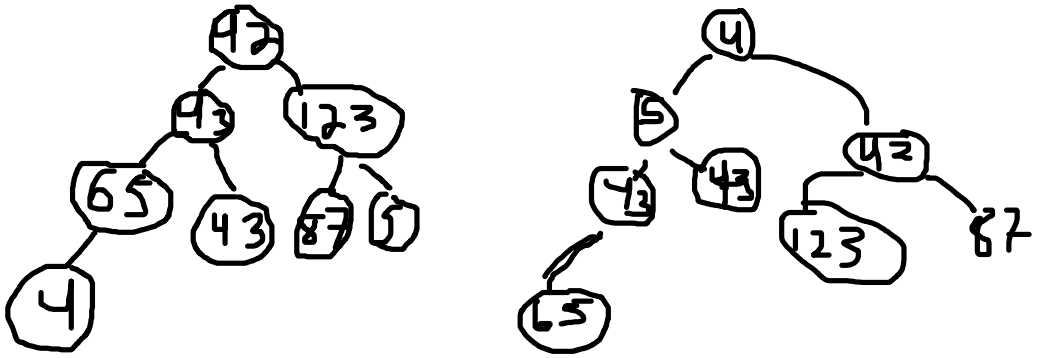
   4, 7, 8, 15, 17, 9, 1

   4, 7, 8, 9, 15, 17, 1

   1, 4, 7, 8, 9, 15, 17

2. What is the run time of the insertion sort algorithm if all items are equal? Briefly explain why.

   The runtime for the insertion O(n) because you will have to search through the entire array to check the values.

3. The worst case runtime for would be O(n^2) if the array was sorted in descending order and you want it sorted in ascending order.
4. 

   4

   4,5

   4, 5 42

   4, 5, 42, 43

   4, 5, 42, 43, 43

   4, 5, 42, 43, 43

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4, 5, 42, 43, 65

4, 5, 42, 43, 65, 87

4, 5, 42, 43, 65, 87, 123

Index i	Parent	L-child	r-child
0	N/A	1	2
1	0	3	4
2	0	5	6
3	1	4	N/A
4	1	N/A	N/A
5	2	N/A	N/A
6	2	N/A	N/A
7	3	N/A	N/A

5. The runtime if the elements in the array are all the same would still be O(nlogn) because you still have to break down the array into multiple subarrays before running the sorting algorithm and putting it back into the original array.

6. Array is sorted in ascending order would result in a runtime of O(nlogn) because you would still have to break down the array into multiple arrays to compare them and put them back together.

7. Array is sorted in descending order would also result in a runtime of O(nlogn) because you have to keep breaking down the array into multiple arrays sort them and put it back into the original array.

8. For this problem, you will be showing how quicksort with median-of-three partitioning processes the input array 3, 1, 4, 1, 5, 9, 2, 6, 5. To do this, show all state changes to the underlying array and briefly explain each state change. Make certain to note the pivot element.

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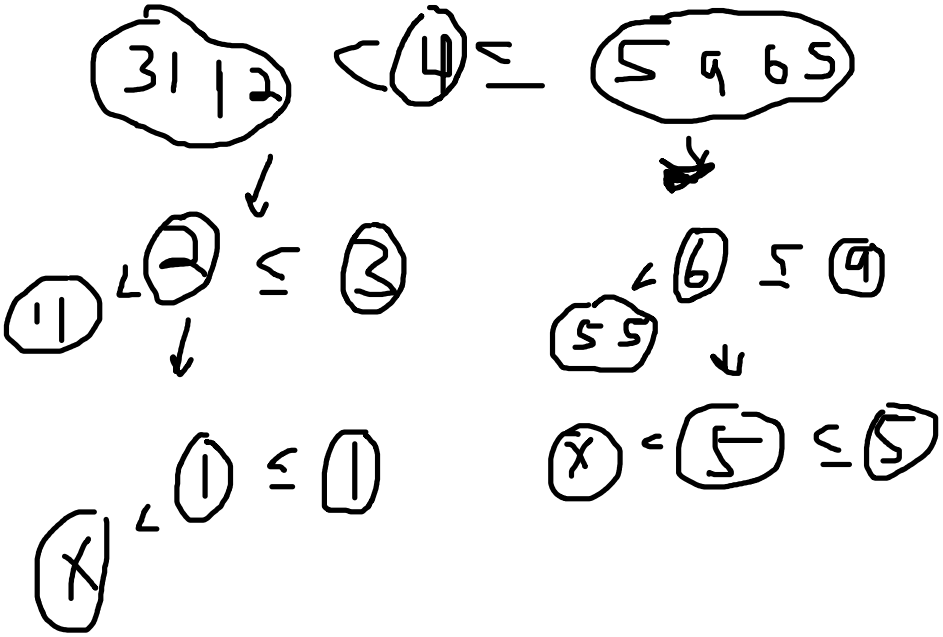
1, 1 ,2, 3, 4, 5, 5 ,6, 9 is the finished array but the pivot points are 4, 2, 1, 6, 5



9. The runtime for both is O(p(N+b)) where p is the number of passes, N is the number of elements and b is the number of buckets. Counting radix sort avoids using vector to represent the buckets. It uses a count to maintain how many items would go on each bucket. The original radix will remain stable while the counting radix wont it wont keep track of where the number came from it just knows that the numbers are the same.

10.

PASS ONE

Letter	Sort	Sort2	Sort3	Sort4
A	ADA	EBA	BBA	CBA
B	DCB			
C	ABC			
D	EAD	DBD	BAD	
E	DAE			
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				
P				
Q				
R				
S				
T				
U				
V				
W				
X				
Y				
Z				

PASS TWO

Letter	Sort	SORT2	SORT3	SORT4	SORT5
A	EAD	BAD	DAE		
B	EBA	BBA	CBA	ABC	DBD
C	DCB				
D	ADA				
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					
O					
P					
Q					
R					
S					
T					
U					
V					
W					
X					
Y					
Z					

PASS THREE

LETTER	SORT	SORT2	SORT3
A	ABC	ADA	
B	BAD	BBA	
C	CBA		
D	DAE	DBD	DCB
E	EAD	EBA	
F			
G			
H			
I			
J			
K			
L			
M			
N			
O			
P			
Q			
R			
S			
T			
U			
V			
W			
X			
Y			
Z			

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PASS ONE

Letter	Sort0	Sort1	Sort2	Sort3	Sort4	Sort5
A	ADA		0			
B	EAD	A	4	0	0	ADA
C	DBD	B	1	4	1	EBA
D	EBA	C	1	5	2	BBA
E	BBA	D	3	6	3	CBA
F	BAD	E	1	9	4	DCB
G	CBA				5	ABC
H	DCB				6	EAD
I	ABC				7	DBD
J	DAE				8	BAD
K					9	DAE

PASS 2

Letter	Count	Sort2	Sort3	Sort4	Sort5	Sort6
A	ADA		0			
B	EBA	A	3	0	0	EAD
C	BBA	B	5	3	1	BAD
D	CBA	C	1	8	2	DAE
E	DCB	D	1	9	3	EBA
F	ABC	E	0	10	4	BBA
G	EAD				5	CBA
H	DBD				6	ABC
I	BAD				7	DBD
J	DAE				8	DCB
K					9	ADA

PASS 3

Letter	Count	Sort2	Sort3	Sort4	Sort5	Sort6
A	EAD		0			
B	BAD	A	2	0	0	ABC
C	DAE	B	2	2	1	ADA
D	EBA	C	1	3	2	BAD
E	BBA	D	3	6	3	BBA
F	CBA	E	2	8	4	CBA
G	ABC				5	DAE
H	DBD				6	DBD
I	DCB				7	DCB
J	ADA				8	EAD
K					9	EBA

11.

Vector of Size

size	Word	Word2	Word3	Word4	Word5
1	C	A			
2	AB	DA	CA		
3	DAD	ABB	CAB	DAB	BAD

VECTOR CURRENTLY

Column1	Column2
0	C
1	A
2	AB
3	DA
4	CA
5	DAD
6	ABB
7	CAB
8	DAB
9	BAD

Sort & Filter

VECTOR OF BUCKETS

Column1	Column2
0	
1	ABB, CAB, DAB
2	
3	DAD, BAD

VECTOR CURRENTLY

Column1	Column2
0	C
1	A
2	AB
3	DA
4	CA
5	ABB
6	CAB
7	DAB
8	DAD
9	BAD

VECTOR OF BUCKETS

Column1	Column2
0	DA,CA, CAB, DAB, DAD ,BAD
1	AB, ABB
2	
3	

VECTOR CURRENTLY

Column1	Column2
0	C
1	A
2	DA
3	CA
4	CAB
5	DAB
6	DAD
7	BAD
8	AB
9	ABB

VECTOR OF BUCKETS

Column1	Column2
0	A, AB, ABB
1	BAD
2	C, CA, CAB
3	DA, DAB, DAD