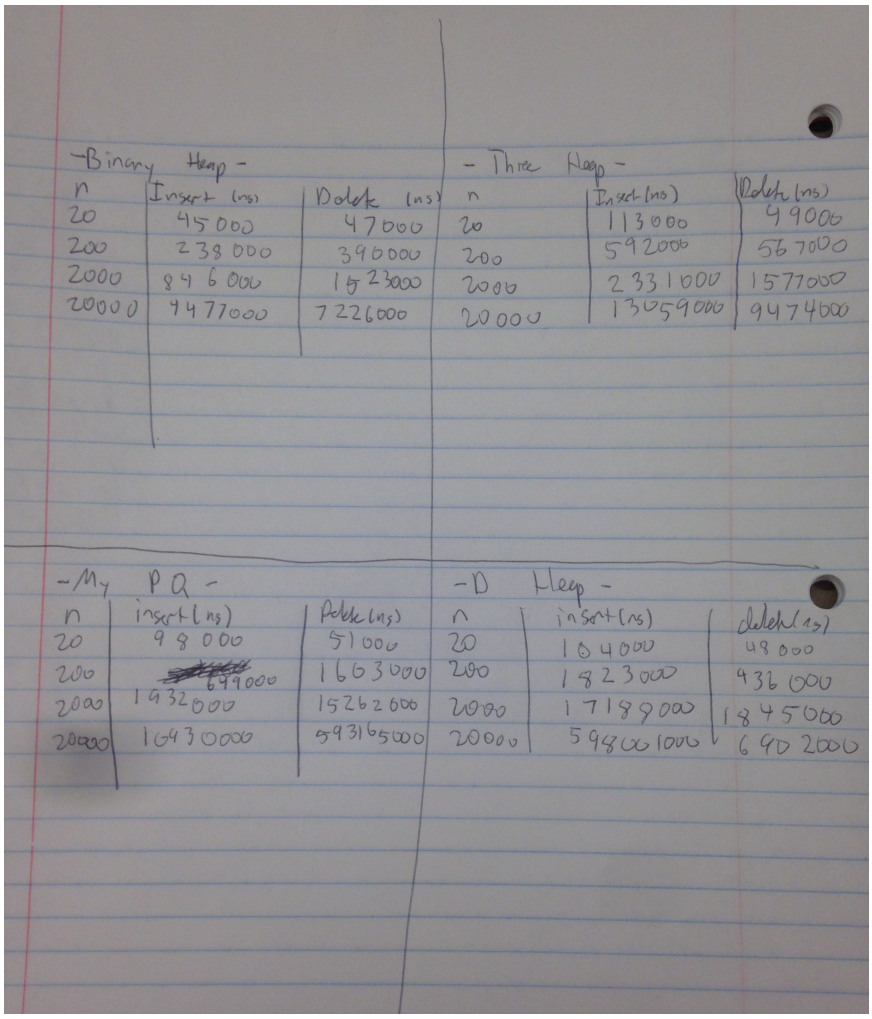
Sam Williams
CSE 373 HW3 Read Me

1 What is the worst case asymptotic running time of isEmpty, size, insert, findMin, and deleteMin operations on all three of your heap implementations? *For this analysis you should ignore the cost of growing the array. That is, assume that you have enough space when you are inserting a value.*

Operation (vertical) Heap (horizontal)	*Binary*	*Three*	*MyPQ*	*D heap*
IsEmpty	*O(1)*	*O(1)*	*O(1)*	*O(1)*
Size	*O(1)*	*O(1)*	*O(1)*	*O(1)*
Insert	*O(log_2(n))*	*O(log_3(n))*	*O(1)*	*O(log_D(n))*
findMin	*O(1)*	*O(1)*	*O(n)*	*O(1)*
DeleteMin	*O(log_2(n))*	*O(log_3(n))*	*O(n)*	*O(log_D(n))*

2 Timing your code: Values of N used : 20, 200, 2000, 20,000 ***NOTE*** In the included testing code the value appearing as 20 in the loop statements was increased by a factor of 10 after each respective compile and run.



-Binary Heap-

n	Insert (ns)	Delete (ns)
20	45000	47000
200	238000	396000
2000	846000	1523000
20000	4477000	7226000

-Three Heap-

n	Insert (ns)	Delete (ns)
20	113000	49000
200	592000	567000
2000	2331000	1577000
20000	13059000	9474000

-My PQ-

n	insert (ns)	Delete (ns)
20	98000	51000
200	~~699000~~	1663000
2000	1932000	15262000
20000	16430000	593165000

-D Heap-

n	insert (ns)	delete (ns)
20	104000	48000
200	1823000	436000
2000	17189000	1845000
20000	598001000	6902000

3 Compare what you see in your experiments, to what you expected to see based on a big-O analysis. (This is also similar to what you did in Homework 2.) In your discussion, answer these questions:

-Binary Heap

a) Big O asymptotic analysis is useful for predicting measured times because I can see that the times for insert and delete asymptotically grow as I expected.

b) N/A

-Three Heap

a) Big O asymptotic analysis is useful for predicting measured times because I can see that the times for insert and delete asymptotically grow as I expected.

b) N/A

-My PQ

a) Big O asymptotic analysis is useful for predicting measured times because I can see that the times for insert and delete asymptotically grow as I expected.

b) N/A

c) In most cases I would recommend a Binary Heap to someone who simply wanted to create a priority Queue. I would recommend a 3 heap to someone who was with a large number of items.
Or If we were restricted by disk space I would recommend a 3 Heap to an individual because D heaps have more values / key, therefore disk access is reduced, therefore disk access is optimized.

4 Briefly discuss how you went about testing your three heap implementations. Feel free to refer to your testing files, which you should submit.

5

I created a test file "HW3_testing" in this file I tested the size, isEmpty, makeEmpty methods of all classes. I also inserted to the heaps elements in ascending order, and the I inserted the same elements in descending order, and made sure the heaps returned the appropriate minimum values when delete or findMin were called while maintaining the correct heap properties and order. I also tested the asymptotic analysis of these operations. ***NOTE*** In the included testing code the value appearing as 20 in the loop statements was increased by a factor of 10 after each respective compile and run as to test where n = 20, 200, 2000, 20,000.

5a)
Assuming That the first element (min element) in the Heap is at index 1.

Binary	i*2	i*2 + 1							
Three	i*3	i*3 +1	i*3-1						
Four	i*4	i*4 +1	i*4-1	i*4-2					
Five	i*5	i*5+1	i*5-1	i*5-2	i*5-3				

5b) For a D-nary tree, ***Assuming*** That the first element (min element) in the Heap is at index 1, the leftmost child is as i*d - (d – 2)