

CSC383 Fall 2011

Midterm Exam-Solution

Name : _____ DePaul Id# : _____

Please put your answers to all questions on the ANSWER SHEET.

Part I : Multiple Choices 10 Questions, 5 points each, total 50 points

1. Finding the minimum value in a linked list of n integers sorted in ascending order is an operation with a runtime complexity

- (a) equal to $\Theta(n)$
- (b) equal to $\Theta(1)$
- (c) that depends on whether the list is singly linked or doubly linked
- (d) that depends on whether or not the list has a tail pointer
- (e) that depends on whether or not the list has a head pointer
- (f) None of the above.

2. A particular function takes a positive integer parameter n and performs exactly $3n+2n \log(n)+50 \log(n)+1000$ steps before returning. What is its runtime complexity?

- (a) $\Theta(1)$
- (b) $\Theta(\log n)$
- (c) $\Theta(n \log n)$
- (d) $\Theta(n)$
- (e) $\Theta(n^2)$
- (f) none of those

3. What is the *worst-case* runtime complexity of searching for an item in a sorted array using binary search?

- (a) $\Theta(1)$
- (b) $\Theta(\log n)$
- (c) $\Theta(n \log n)$
- (d) $\Theta(n)$
- (e) none of those

4. If you have a sorted array of 1024 integers, what is the maximum number of comparisons against the target item for a successful search that might be performed by binary search?

- (a) 1
- (b) 10
- (c) 11
- (d) 12
- (e) 1023

5. Removing the last element of singly-linked list with a tail pointer is an operation with a runtime complexity of

- (a) $\Theta(1)$
- (b) $\Theta(\log n)$
- (c) $\Theta(n \log n)$
- (d) $\Theta(n)$
- (e) $\Theta(n^2)$
- (f) none of those

6. Removing the last element of a doubly-linked list with a tail pointer is an operation with a runtime complexity of

- (a) $\Theta(1)$ (b) $\Theta(\log n)$ (c) $\Theta(n \log n)$ (d) $\Theta(n)$ (e) $\Theta(n^2)$ (f) none of those

7. What does it mean to say that an operation takes constant time?

- (a) the operation takes the same time in every computer.
(b) the operation takes an amount of time that is independent of the size of its input.
(c) the operation takes an amount of time equal to the size of its input plus some constant.
(d) the operation takes an amount of time equal to the size of its input times some constant.
(e) the operation takes an amount of time that is independent of how long your algorithm has been running.

8. Which of the following is an advantage of using an array versus using a linked list?

- (a) arrays are always sorted.
(b) arrays support more data types.
(c) array indices start at zero.
(d) arrays don't require any memory.
(e) accessing an arbitrary element in an array is faster.

9. Characterize, using the big-Oh notation, the worst-case running time of the following algorithm:

Let A be a given array of n integers.

```
for i <- 0 to n log n do
  for j <- 0 to n2-1 do
    Let A[i mod n] <- A[i mod n] + j.
  end for
end for
```

The Best characterization is : c) $\Theta(n^3 \log n)$

- (a) $\Theta(n \log n)$ (b) $\Theta(n^2 \log n)$ (c) $\Theta(n^3 \log n)$ (d) $\Theta(n^4 \log n)$
(e) none of these

10. To sort an array of size n using Quicksort algorithm, the best case complexity is

- (a) $\Theta(1)$ (b) $\Theta(\log n)$ (c) $\Theta(n \log n)$ (d) $\Theta(n)$ (e) $\Theta(n^2)$ (f) none of those

Part II.

1. (10 pts) Suppose that a client performs an intermixed sequence of (stack) push and pop operations. The push operations put the integers 0 through 9 in order onto the stack; the pop operations print out the return value. Which of the following sequence(s) could not occur? (May be more than one sequence.)

- a) 4 3 2 1 0 9 8 7 6 5
b) 2 5 6 7 4 8 9 3 1 0
c) 4 6 8 7 5 3 2 9 0 1
d) 4 3 2 1 0 5 6 7 8 9
e) 1 2 3 4 5 6 7 8 9 0
f) 0 4 6 5 3 8 1 7 2 9

2. (10 pts) Given the array representation of a binary tree :

A :

2	3	4	5	1	9	0	4
---	---	---	---	---	---	---	---

Apply the heapify algorithm to make it into a max-heap. What is the array representation of the resulting max-Heap ?

A :

9	5	4	4	1	2	0	3
---	---	---	---	---	---	---	---

3 Postfix expression (20 pts)

a) Convert the following infix expression into postfix expression:

$$(d \times f + k) \times e^{(a \times b^c d - e / g + h)} + a \times b^c$$

Answer : _____

b) Assume that $a = 2$, $b = 3$, $c = 4$, $d = 5$ and $e = 6$.

Is the following expression a valid postfix expression?

$$e a^b c \times / c b \times c \times a d a - c a - ^ + +$$

If yes, evaluate the expression using postfix evaluation algorithm.
 (** integer arithmetic is assumed, i.e. the fraction part will be discarded. For example, $3/2 = 1$ instead of 1.5 **)

Answer: _____

a) $d f \times k + e a b c d ^ ^ \times e g / - h + ^ \times a b c ^ \times +$

b) 563

4. For each of the following code segment, what is the running time complexity (in term of N)?

Choose one from below :

$\Theta(1)$, $\Theta(\log n)$, $\Theta(n \log n)$, $\Theta(n)$, $\Theta(n^2)$

```
a)   l = N ;  
      while ( l > 0 ) {  
          for ( int k = 0 ; k < N ; k++ ) {  
              x++ ;  
          }  
          l = l / 2 ;  
      }
```

$\Theta(n \log n)$

```
b)   Int fun4b(int n) {  
      if ( n == 0 ) return 0 ;  
      return fun4b(n-1) ;  
  }
```

$\Theta(n)$

```
c)   Int fun4c(int n ) {  
      If ( n == 0 ) return 0 ;  
      return fun4c(n/2) ;  
  }
```

$\Theta(\log n)$

Answer sheet for Name : _____ DePaul id#: _____

Part I.

Question#	Answer :	Question#	Answer:
1	b	6	a
2	c	7	b
3	b	8	e
4	b	9	c
5	d	10	c

Part II.

Q1. Circle the answers : (a) (b) (c) (d) (e) (f)

Q2. A :

9	5	4	4	1	2	0	3
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Q3. A) Postfix expression :

a) $df \times k + eabcd^{^^} \times eg / - h + ^ \times abc^ \times +$

B) answer : 563

Q4. Circle the correct answer for each part :

a) $\Theta(1)$, $\Theta(\log n)$, $\Theta(n \log n)$, $\Theta(n)$, $\Theta(n^2)$

b) $\Theta(1)$, $\Theta(\log n)$, $\Theta(n \log n)$, $\Theta(n)$, $\Theta(n^2)$

c) $\Theta(1)$, $\Theta(\log n)$, $\Theta(n \log n)$, $\Theta(n)$, $\Theta(n^2)$