Midterm 2 (CSC 225)
June 18, 2013

V#	Name

Instructions

• Duration: 50 minutes

• All answers are to be written on examination paper

• There are 5 questions on 8 pages. Marks for each questions are indicated on the question sheet.

• This is a no-aids midterm.

• For multiple-choice questions, you *must* circle true (T) or false (F) for *every* of the answers.

Q 1 [14 marks]	
Q 2 [8 marks]	
Q 3 [10 marks]	
Q 4 [15 marks]	
Q 5 [8 marks]	
Total [55 marks]	

Question 1. [14 marks] For each of the following questions circle *(all)* the correct answer(s).

a) A heap is a priority queue. T F

b) A queue follows the FIFO principle. T F

c) Given a binary search tree, any of its elements can be located in O(1) time. T F

d) Given a heap, its element with maximum priority extracted in O(log n) time. T F

e) The lower bound of comparison based sorting is

i. $\Omega(n^2)$. T F

ii. $\Omega(n \log n)$ T F

f) The following data structure(s) support(s) constant access to any of its elements.

i. heap T F

ii. stack T F

iii. binary search tree T F

iv. vector T F

g) A binary tree with exactly n *leaves* has exactly the following number of nodes (that is, internal nodes and leaves).

i. n T F

ii. 2n T F

iii. 2n-1 T F

h) 4^n is $O(3^n)$. T F

Question 2. [8 marks] Given is the following sequence of numbers:
4 8 2 6 1 5 3 7

Assume a Quicksort implementation that chooses the first element of the sequence as pivot.

In the box, list all elements that are chosen as pivots when running quicksort on above sequence. Show your work.

Question 3. [10 marks] Order the following functions by their growth rate. *Indicate the direction of growth!*

a) $2^{\log n} + 3n$

b) $17 \cdot n \log n$

c) n^2

d) $17 \cdot 2^n + 83$

e) $n \cdot n^4$

f) $4^n \cdot 33$

g) $71 \cdot 1^n$

h) $311 \cdot n^1$

i) $(1/n) \cdot n$

Question 4. [15 marks]

a) Describe the subroutine *merge* of sorting algorithm *mergesort* that merges to sorted sequences into one sorted sequence in linear time.

b) Describe the recurrence for T(n), where T(n) described the running time of *mergesort.*

c) Determine big-Oh of T(n) from a).

Question 5. [3+3+2 marks]

a) Briefly describe the algorithm design technique divide and conquer.

b) Briefly describe what a binary search tree is.

c) What is the maximum height of a binary search tree storing n elements? Justify your answer.