

# Eric Lewis

Discrete Structures and Algorithms II						
Final Review						
Code	MAT 2540		Last Name:			
Acad. Year	2016		Name :			
Semester	Spring		Student # :			
Date	05.20.2016					
Est. Time : 1 hr 15 min			7 QUESTIONS TOTAL 100 POINTS			
1. ()	2. ()	3. ()	4. ()	5. ()	6. ()	

Please draw a  around your answers. No calculators, cell-phones, notes, etc. allowed.

1. (pts) (a) Describe in words how the binary search algorithm works.

(b) Use pseudocode to describe the the binary search algorithm.

(c) Build a binary search tree for the words (oenology, phrenology, campanology, ornithology, ichthyology, immunology, alchemy, astrology); using alphabetical order. Show each step of the binary search algorithm as it searches for the word "ichthyology".

2. (pts) Let  $f(n)$  and  $g(n)$  be functions from the set of positive integers to the set of real numbers. State the definition of the fact that  $f(n)$  is  $O(g(n))$ . (b) Use your definition from (a) to prove that  $1^2 + 2^2 + \dots + n^2$  is  $O(n^3)$ . Show all your work.

3. (pts) Explain what it means for a function to be  $\theta(1)$ .

4. (pts) (a) What is a spanning tree? (b) What is a minimum spanning tree?

5. (pts) Fill in a tic-tac-toe board up to a point with two empty spots. Draw the subtree of a game for the remainder of the tic-tac-toe game. Assume that X is player 1 and O is player 2.

6. (pts) Use backtracking to find a subset, if it exists of the set 27,2,19,14,11,8 with sum: a) 20  
b) 41 c) 60.

7. (pts) Use strong induction to show that every positive integer  $n$  can be written as a sum of distinct powers of two, that is, as a sum of a subset of the integers  $2^0 = 1, 2^1 = 2, 2^2 = 4$ , and so on. [Hint: For the inductive step, separately consider the case where  $k + 1$  is even and where it is odd. When it is even, note that  $(k + 1)/2$  is an integer.]