Homework #3
Due Friday, 4/14
(at the beginning of class)

This homework is the sole work of: _____ whose conference section is at:

_____ whose conference section is at:

Sources (People, URL's, Books etc.) consulted:

Source _____ for Problem # _____

Source _____ for Problem # _____

Source _____ for Problem # _____

Date: _____

#1. (2 Points) Play with the domino presentation at:
http://web.cs.wpi.edu/~kal/courses/cs503/module0/domino_part1.html and **and**
http://web.cs.wpi.edu/~kal/courses/cs503/module0/domino_part2.html and (for the 2 points) tell us whether it helped you and why or why not.

#2. (6 points) Section 2.2, #2: Determine whether each of these functions is $O(x^2)$.

a) $f(x)=17x+11$
b) $f(x)=x^2+1000$
c) $f(x)=x \log x$
d) $f(x)=x^4/2$
e) $f(x)=2^x$
f) $f(x)=\lfloor x \rfloor * \lceil x \rceil$

#3. (12 Points) Section 2.2 #22 (Hint: it may help to check the answers to #1 in the library first)
For each function in Exercise 1, determine whether that function is $\Omega(x)$ and whether it is $\Theta(x)$.

Functions from Exercise 1, Section 2.2:

a) $f(x)=10$
b) $f(x)=3x + 7$
c) $f(x)=x^2 + x + 1$
d) $f(x)=5 \log x$
e) $f(x)=\lfloor x \rfloor$
f) $f(x)=\lceil x/2 \rceil$

#4. (4 Points) Section 2.3, #14 An algorithm is called **optimal** for the solution of a problem with respect to a specified operation if there is no algorithm for solving this problem using fewer operations.

a) Show that Algorithm 1 in Section 2.1 is an optimal algorithm with respect to the number of comparisons of integers. (Note: Comparisons used for bookkeeping in the loop are not of concern here.)

Algorithm 1 from section 2.1: Finding the Maximum Element in a Finite Sequence

procedure max (a_1,a_2,…a_n: integers)
max :=a_1
for k:=2 **to** n
  if max<a_k **then** max:=a_k
{max is the largest element}

b) Is the linear search algorithm optimal with respect to the number of comparisons of integers (not including comparisons used for bookkeeping in the loop)?

Linear Search Algorithm

procedure linear search (x: integer, a_1,a_2,…a_n: distinct integers)
k:=1

while (k<=n and x<>a_k)
  k:=k+1
if k<=n **then** location := k
else location := 0
{location is the subscript of the term that equals x, or is 0 if x is not found}

#5. (4 Points) Section 3.3, #12 Prove (using induction) that $3^n < n!$ (n factorial) whenever n is a positive integer greater than 6.

#6. (4 Points) Section 4.1, #44 Every student in a discrete mathematics class is either a CS or a Math or is a joint major in these two subjects. How many students are in the class if there are 38 CS majors (including joint majors), 23 Math majors (including joint majors) and 7 joint majors?

#7. (4 Points) Section 4.3, #14 In how many ways can a set of two positive integers less than 100 be chosen?

#8. (4 Points) Section 5.1, #8 What is the probability that a five-card poker hand contains the ace of hearts?