CS 173, Fall 2015
Examlet 12, Part A

NETID:

FIRST: **LAST:**

Discussion: Thursday 2 3 4 5 Friday 9 10 11 12 1 2

(a) (9 points) A triomino is a triangular tile with a number on each edge. In our set of triominos, the numbers range from 0 to 5. So possible tiles include 5-3-4, 0-4-4, and 3-3-3. The back of each tile has a pretty pattern, so tiles can't be turned over. However, notice that a tile is the same if you rotate it, e.g. 5-3-4 is the same tile as 3-4-5. How many distinct tiles are in our set?

(b) (6 points) State the negation of the following claim, moving all negations (e.g. "not") so that they are on individual predicates.

> There is a bug b, such that for every plant p, if b pollinates p and p is showy, then p is poisonous.

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(a) (9 points) In the polynomial $(x+y+z)^{30}$, what is the coefficient of the $x^{15}y^6z^9$ term. Briefly justify your answer.

(b) (6 points) State the negation of the following claim, moving all negations (e.g. "not") so that they are on individual predicates.

For every cat c, if c is not fierce or c wears a collar, then c is a pet.

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FIRST:	**LAST:**

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(a) (9 points) Use proof by contradiction to prove that, for all real numbers a and b, if a is rational and b is irrational, then $a + b$ is irrational. (You must use the definition of "rational." You may not use facts about adding/subtracting rational numbers.)

(b) (6 points) In the game Tic-tac-toe is played on a 3x3 grid and a move consists of the first player putting an X into one of the squares, or the second player putting an O into one of the squares. The board cannot be rotated, e.g. an X in the upper right corner is different from an X in the lower left corner. How many different board configurations are possible after four moves (i.e. two moves by each player)?

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(a) (9 points) Use proof by contradiction to show that $\sqrt{21} \leq \sqrt{7} + \sqrt{5}$.

(b) (6 points) Someone left the following equation on the hallway whiteboard. Is it correct? Explain why or why not. (Be clear but a formal proof is not required.)

$$\sum_{k=0}^{50} \binom{101}{2k} = \frac{1}{2} \sum_{k=0}^{101} \binom{101}{k}$$

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(a) (9 points) Use proof by contradiction to show that $\sqrt{2} + \sqrt{3} \leq 4$.

(b) (6 points) Suppose that w, x, y, and z are **positive** integers. How many solutions are there for the equation $w + x + y + z = 120$? Briefly explain or show work.

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FIRST: **LAST:**

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(a) (9 points) Suppose we know that $\sqrt{6}$ is irrational. Use proof by contradiction to show that $\sqrt{2}+\sqrt{3}$ is irrational. (You must use the definition of "rational." You may not use facts about adding/subtracting rational numbers.)

(b) (6 points) The bus to the Hackathon has 40 seats. In how many ways can I divide these seats among the CS, ECE, Math, and Physics departments?