Homework 12 REALLY Due May 12
NOTE- MAY 12 is THE LAST DAY OF CLASS

1. (0 points) Where and when is the final?

2. (30 points) Give a clean statement of the form
   $$PI \text{ wins } NIM(1,k) \text{ on } n \text{ stones iff } XXX$$
   where XXX depends on k and n.
   (HINT: Work out the pattern for $NIM(1,2)$, $NIM(1,3)$, $NIM(1,4)$, $NIM(1,5)$, $NIM(1,6)$ until you see a pattern of patterns. Start at 0.)

3. (40 points) Read my notes on Mono Squares which is posted. You may use Lemma 2.4 from those notes.
   (a) Show that there exists a number M such that for all 3-colorings of the $M \times M$ grid there is a mono square.
   (b) Show that for all c there exists a number M_c such that for all c-colorings of the $M_c \times M_c$ grid there is a mono square.

4. (30 points) Let $A = \{1,2,3,4\}$.
   (a) How many relations are there over the set A?
   (b) Of those, how many are functions?
   (c) If I pick a relation at random what is the probability that its a function?