

# MA/CSSE 473 – Design and Analysis of Algorithms

## Homework 9 (51 points total) Updated for Summer, 2013

When a problem is given by number, it is from the textbook. 1.1.2 means “problem 2 from section 1.1” .

### Problems for enlightenment/practice/review (not to turn in, but you should think about them):

How many of them you need to do serious work on depends on you and your background. I do not want to make everyone do one of them for the sake of the (possibly) few who need it. You can hopefully figure out which ones you need to do.

- 5.5.4 (multiplication à la Russe)
- 5.5.7 (Josephus problem for  $N=40$ )
- 5.5.9 (Prove properties of Josephus solutions)

### Problems to write up and turn in:

1. ( 8) (Nim strategy) In class ([Day 23 in in the Summer, 2013 schedule](#)) we stated that in  $n$ -pile Nim, a player is guaranteed to be able to win if and only if the nim sum (as defined in class ) is nonzero at the beginning of that player's turn. We proved three lemmas ([Slide 8](#)) that can be used to prove this statement (see the ICQ solution from that day for details). Use one or more of these lemmas to construct a proof by induction (on the total number of chips in all of the piles?) that the statement is correct for any nonnegative number of piles and any non-negative number of chips.
2. ( 5) Using the algorithm from class (and referenced in the previous problem) consider the following situation:

Pile #	Chips
1	77
2	46
3	27
4	74

Which pile should the player take chips from and how many chips should be taken in order to guarantee a win? Show your work.

3. ( 6) 4.4.8 [5.5.2] (Ternary Search)
4. (12) 4.4.10 [5.5.3] (fake coin divide-into-three) Levitin made me do it!
5. (20) 4.5.11a [5.6.10a] (moldy chocolate) This problem may be harder than first appears to be. "Transform and conquer" is a good way to find a complete solution, so you may want to look ahead to Chapter 6. . However, if you can't solve the general case, get some partial credit solve some cases that you can solve, and write about what you tried for other cases. **In the past, several students said that this problem took them longer than any previous problem in the course.**