University of Toronto at Scarborough
CSCC73 - Algorithm Design and Analysis

Assignment #3: Divide and Conquer

Due: Feb 4, 2023 at 11.59pm This exercise is worth 5% of your final grade.

Warning: Your electronic submission on MarkUs affirms that this exercise is your own work and no one else's, and is in accordance with the University of Toronto Code of Behaviour on Academic Matters, the Code of Student Conduct, and the guidelines for avoiding plagiarism in CSCC73. Late assignments will not be accepted. If you are working with a partner your partners' name must be listed on your assignment and you must sign up as a "group" on MarkUs. Recall you must not consult **any outside sources except your partner, textbook, TAs and instructor**.

1. (10 marks) You have been given a challenge by your younger sibling to sort their bucket of magnets. (S)he has a bucket of n magnets that appear to be identical however some are positively charged and some are negatively charged. There are more positively charged magnets than negatively charged. When you put two oppositely charged magnets together they attract each other. When two identically charged magnets are put together, they repel each other. Give a divide and conquer $\mathcal{O}(n)$ algorithm to sort the magnets into positives and negatives.

2. (10 marks) In lecture we looked at two sequences of numbers and measured their similarity by counting the number of inversions. As in lecture we will consider a sequence of n numbers $x_1, x_2, \ldots, x_n$ which we assume are all distinct. We defined an inversion to be a pair $i < j$ such that $a_i > a_j$. In this situation, we make the definition of an inversion coarser and now call a pair an inversion if $i < j$ and $a_i > 2a_j$. Give an $\mathcal{O}(n \log n)$ algorithm to count the number of coarse inversions.