CS472 Assignment 3: Implementing Brute Force and Divide-and-Conquer Algorithms

CS472 - Analysis of Algorithms

February 14, 2017

1 Overview

The assignment contains a set of programming problems that use brute force and divide-and-conquer algorithms.

2 Problems

1. An important problem in conservation management is determination of the home range of an animal population. Wildlife biologists solve this problem by tagging a sample population and tracking location reports on a map of the area in which the sample population lives. An estimate on the home range is computed by finding the convex hull of the 2-d point cloud formed on the map by the observation locations.

   Assume that we have a tagged population that is living in an area upon which we overlay a 1000 by 1000 meter grid. Write a program that reads a collection of observations from a data file (stored as x-y points, one per line, you will need to write a simple program that randomly generates one of these files) and determines the home range of the population by reporting the list of points that form the convex hull of the observation locations. Use the brute force algorithm presented in class to compute the convex hull.

2. At some time in our life, we are introduced to the game of dominoes. The term "domino" comes from the fact that the playing piece in the game has only two cells. Consider the next level of tromino: a playing piece that can contain three possible cells. Ignoring rotations and

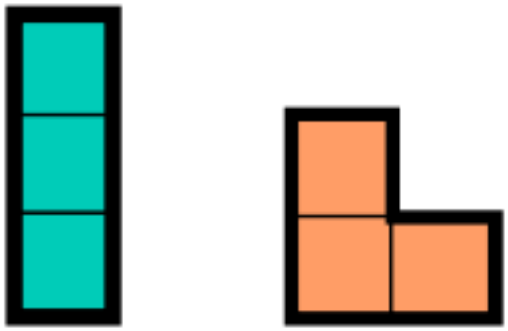

Figure 1: All possible free trominos

reflections, there are only two possible shapes a tromino can take: an "I" shape and an "L" shape (see Fig. 1).

Consider the following tiling problem: we have a game board that is an n by n array of unit squares where $n \geq 4$ and is some positive power of 2. There is one randomly selected square that is a forbidden square; i.e., no tromino can be placed in that square. Write a program that will output a `tiling` of the array that satisfies the following conditions:

- Every unit square other than the forbidden square is covered by a tromnio.
- No tromnio covers the forbidden square.
- No two tromnios overlap.
- No tromnio extends beyond the board.

Write a program in your favorite programming language that solves this tiling problem.

2.1 Hints

Well... we are talking about divide and conquer algorithms. So: recursion. Write out the base case and the possible recursive steps. This is a problem where it ***`REALLY`*** helps to write the algorithm before you start trying to sling code.

Also, note that one will find many possible solutions to this problem by doing a few searches on the Internet. Be careful... I've done the same searches and it should be noted that many of the solutions that show up in

search results are wrong. If you do decide to "program by Google", remember to cite sources.

3 Submission instructions

You will need to attach a PDF file to your problem submission in Blackboard that details your responses to the questions in the previous section.