Assignment #3

APA - Master in Bioinformatics for Health Sciences

November 7^{th}, 2019

Problem set

1. Write an iterative version of the HANOITOWERS(n, fromPeg, toPeg) algorithm presented on Page 26 of the *"An Introduction to Bioinformatics Algorithms"* book (see lecture notes #1-2, slide #2 for full details of the book).

2. Write the pseudocode to traverse a binary tree by levels but starting from leaves instead of the root (see lecture notes #5-6, slide #27 for the pseudocode for traversal by levels starting from the root). Provide the computational complexity of the proposed algorithm in terms of asymptotic bounds.

3. A graph G(V, E) is a *bipartite graph* if its vertices can be divided into two disjoint and independent sets U and W such that every edge connects a vertex in U to one in W ($U \subset V, W \subset V, U \cap W = \emptyset, U \cup W = V$). A graph is bipartite if it is 2-colorable. That is, if one colors all nodes in U with one color, and all nodes in W with another color, each edge has endpoints of differing colors. Prove that a graph is bipartite iff (if and only if) it does not contain any odd-length cycles. *(Hint: use possible configuration of vertices at the same levels in Breadth First Search).*

4. (*Problem 4.5* in the book) Sets A and B are said to be homometric if $\Delta A = \Delta B$, where $\Delta X = \{x_j - x_i : 1 \leq i < j \leq n\}$. Let U and V be two sets of numbers. Prove that the sets $U \oplus V = u + v : u \in U, v \in V$ and $U \ominus V = \{u - v : u \in U, v \in V\}$ are homometric for any two sets U and V.

5. (Choose one: either *Problem 6.31* or *Problem 6.32* in the book) Provide an efficient algorithm for either interwoven strings problem or shortest supersequence problem (see the book for the definitions of these problems).

6. Describe how two randomized algorithm design techniques *Las Vegas* and *Monte Carlo* differ and name an example algorithm for each case.

7. Provide the expected value for x in the following Python 3 expressions

   - x = [0] * 3
   - x = [1, 2] * 3
   - x = (2) * 3
   - x = (2, 1) * 3
   - x = map(len, zip([1, 2])); x = print(x)
   - x = zip(*['a' * 3], map(len, zip(['2'] * 3))); x.__next__()
   - x = [x for x in map(lambda x: x ** 2 / 2 ** 2, [2, 4])]

Deadline and submission instructions

The due date for the problem set is November 19^{th}. You could bring a hard copy to the class of the same day or email your solutions to emre.guney@upf.edu .