CSC 226 SUMMER 2018
ALGORITHMS AND DATA STRUCTURES II
ASSIGNMENT 2 - WRITTEN
UNIVERSITY OF VICTORIA

1. (a) Draw the 2-3 tree that results when you insert the keys S E A R C H X M P L Y in that order into an initially empty tree. Construct the corresponding red-black tree.

   (b) Find a sequence of keys to insert into a BST and a red-back BST such that the height of the BST is less than the height of the red-black BST, or prove that no such sequence is possible.

2. Define *right-leaning* red-black BSTs as BSTs having red and black edges satisfying the following three restrictions:
   i. Red links lean *right* only.
   ii. No node has two red links connected to it.
   iii. Every path from the root to a leaf has the same black depth.

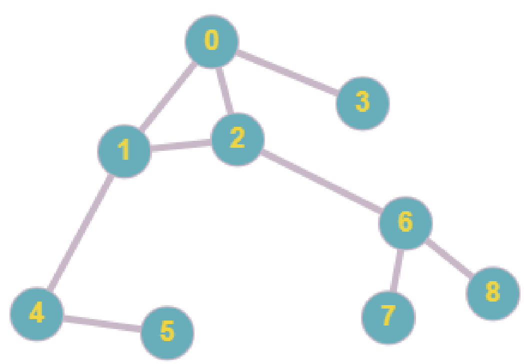
   (a) Rewrite the put() method, on page 439 of the Sedgewick book, so that it works for right-leaning red-black trees instead of left-leaning red-black trees.

   (b) Using a construction proof, show that for every right-leaning red-black tree there is a corresponding left-leaning red-black tree.

3. Let $G = (V, E)$, where $V = \{a, b, c, d, e, f, g, h\}$ and $E = \{\{a, b\}, \{a, c\}, \{b, c\}, \{b, d\}, \{b, g\}, \{c, d\}, \{e, f\}, \{e, g\}, \{f, g\}, \{f, h\}, \{g, h\}\}$.
   (a) Draw the corresponding graph with no edges crossing.
   (b) How many paths are there in G from a to h?
   (c) How many of these paths have length less than 5? List them.

4. Let $G = (V, E)$ be an undirected graph, with no parallel edges or self-loops. Let $|V| = n$ and $|E| = m$. Prove by induction that $2m \leq n^2 - n$ for all $n \geq 1$.

5. Consider the graph G shown below:



   (a) How many spanning subgraphs are there?
   (b) How many connected spanning subgraphs are there?
   (c) How many of the spanning subgraphs have vertex 0 as an isolated vertex?