Due date: Monday, October 31at 7:30 AM. You will need to submit this via GradeScope.

For this assignment, each answer must be contained within a single piece of paper. When you submit to GradeScope, you will need to inform the system which page of your scanned PDF contains the answer. *Do this even if your submission is a single page.*

Please review the syllabus and course reference for the expectations of assignments in this class. Remember that problem sets are not online treasure hunts. You are welcome to discuss matters with classmates, but remember the Kenny Loggins rule. Remember that you may not seek help from any source where not all respondents are subject to UC Irvine's academic honesty policy. It is an egregious academic honesty violation to look for answers online and present them as your own.

1. Recall the definition of a *binary search tree*: a binary tree is a binary search tree if:

   - It is a nullptr
   - It is not a nullptr, has a key, and:
     - The left-hand child is a binary search tree, all of whose keys are less than this node's value.
     - The right-hand child is a binary search tree, all of whose keys are greater than this node's value.

   (a) There are five possible binary search trees (down to isomorphism) with three nodes. Draw them.

   (b) There is only possible binary search tree of size one (one vertex), there are two of size two, five of size three, and 14 of size four. Use this information to determine how many binary search trees of size five are possible. *An answer that does not use this information in a meaningful way to solve the problem will cause you to receive zero credit for the entire problem.*

2. Suppose we had a binary search tree where each node's value is a letter of the alphabet, and the comparison between two letters is based on alphabetical order.

   The relevant portion of alphabetical order, smallest to largest, is ABCDEFGHIJKLM How many such binary search trees do we have that obey all of the following properties?

   - The tree's values consists of only the letters A through M, inclusive (thirteen letters total).
   - Each of these letters appears exactly once in the tree.
   - The root node of the tree is the letter 'J'
   - The root's left hand child is the letter 'E'

   Be sure to explain how you got your answer. A response that does not show your work in a meaningful way will receive zero credit for the problem.

   Hint: Draw out, as generally as you can, every tree that meets these requirements.

3. I have a binary (**not** a binary search tree) with the following properties:

   - Each non-null[1] node of T contains a single character
   - An in-order traversal of the tree reads "H, X, B, W, M, J, G, S, R, Y, P, T"
   - A post-order traversal of the tree reads "H, X, W, M, J, B, S, R, T, P, Y, G"
     This is a reminder that this is not a binary search tree.

   Draw the tree. Briefly explain (1-2 sentences) how you decided that is the tree that meets this criteria.

[1]Depending which textbook you are reading, this either means "all the internal nodes" or "all the internal nodes AND all the leaf nodes," so I am trying to be less ambiguous by saying every non-null node.