VE281 Writing Assignment Four

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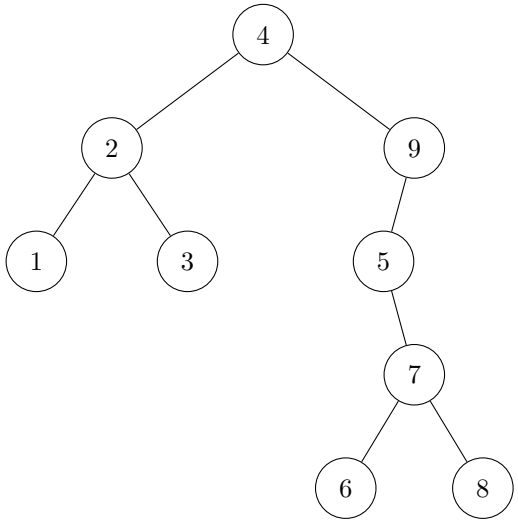
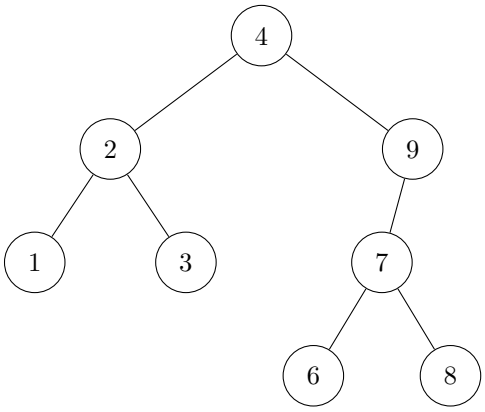
Ex. 1

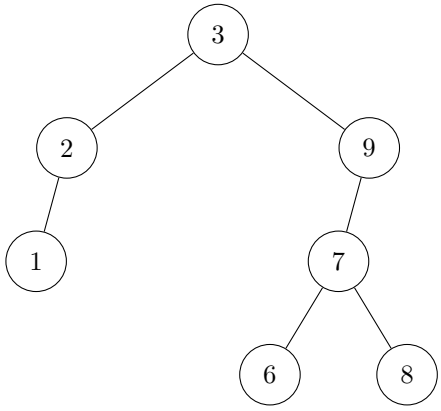
(a)



(b)



(c)



Ex. 2

Input: A non-empty binary tree with root node *root*
Output: Whether the tree is a binary search tree

```
function EXAMINE(root)
    if root.left is empty then
        flag ← true
    else if root.left.key > root.key then
        flag ← false
    else
        flag ← EXAMINE(root.left)
    end if
    if not flag then
        return flag
    end if
    if root.right is empty then
        flag ← true
    else if root.right.key < root.key then
        flag ← false
    else
        flag ← EXAMINE(root.right)
    end if
    return flag
end function
```

We know that if we want to ensure the tree is a binary search tree, at least every node should be verified once. In my algorithm, each node is verified exactly once, which should be a most runtime-efficient one. The runtime is $\Theta(n)$.

Ex. 3

```
node *getPredHelper(node *root, Key key, node *parent) {
    if (root == NULL) return NULL;
```

```
    if (key == root->key) {
        if (root->left) return findMax(root->left);
        return root;
    }
    node *temp = NULL;
    if (key < root->key) temp = getPredHelper(root->left, key, root);
    if (!temp) temp = getPredHelper(root->right, key, root);
    if (!temp) return NULL;
    if (key == temp->key) {
        if (root->key < key) return root;
        if (!parent) return NULL;
    }
    return temp;
}

node *getPred(node *root, Key key) {
    return getPredHelper(root, key, NULL);
}
```

Ex. 4