

[**Closed book and notes.**] Show all of your work clearly in the space provided. Be sure to **read each problem carefully**. Note that the exam is double sided.

1. (10 points) Suppose you are asked to implement a `PureStack` using either an `ArrayList` or a `LinkedList`. Is there a significant reason for using one over the other? Why or why not?

2. (10 points) Suppose you are asked to implement a `PureQueue` using either an `ArrayList` or a `LinkedList`. Is there a significant reason for using one over the other? Why or why not?

3. (20 points) Implement a recursive version of the `contains` method for a binary search tree. Assume that an empty tree has a `root==null` and that the recursive version is called as follows:

```
public boolean contains(E target) {  
    return contains(root, target);  
}
```

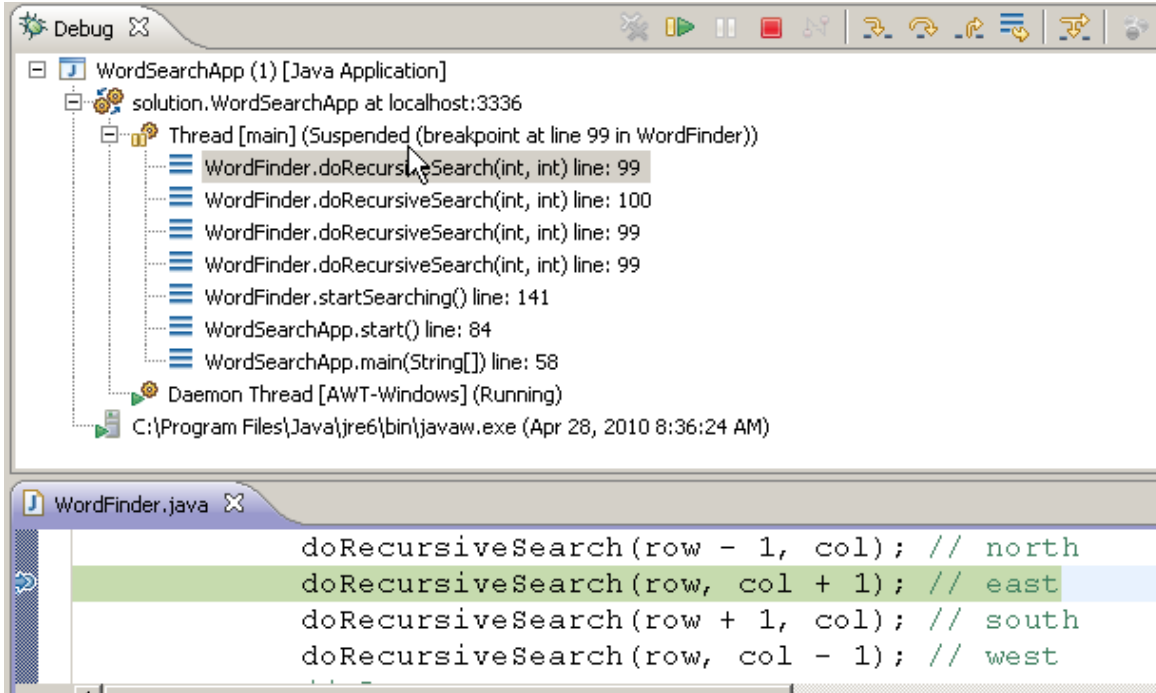


4. (20 points) Implement a non-recursive version of the `contains` method for a binary search tree. Assume that an empty tree has a `root==null`.

5. (5 points) What is the worst-case asymptotic time complexity of for the `contains` method implemented in problem 3? Justify your answer.

6. (5 points) What is the worst-case asymptotic time complexity of for the `contains` method implemented in problem 4? Justify your answer.

7. (15 points) The screen capture below is from running a recursive algorithm that is very similar to the code you wrote for your `doRecursive4WaySearch` method in lab 6.



Suppose the algorithm is acting on the grid of letters below and was started on the letter **H** (`doRecursiveSearch(0, 0)`).

H	E	A	S
I	L	P	O
M	R	D	C
N	U	T	G

What is the current value of `currentWord` in the running of the program suspended by the debugger? Explain your answer.

8. (15 points) Draw the following binary search tree after the 11 is removed.

