Name: \_\_Daniel Grimshaw\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Searches Assignment**

1. Why does the binary search algorithm require the input to be sorted?

It needs to be able to start at the median value.

2. How many elements (at most) does a binary search examine if the array contains 60 elements?

5 elements.

3. Complete the table below for the binarySearch method. Replace each ‘?’ with a value.

/\*\*

\* Find the index of a value in an array of integers sorted

\* in ascending order.

\* @param elements an array containing the items to be searched.

\* **Precondition:** items in elements are sorted in ascending order.

\* @param target the item to be found in elements.

\* @return an index of target in elements if target found;

\* -1 otherwise.

\*/

 public static int binarySearch(int[] elements, int target)

{

int left = 0;

int right = elements.length − 1;

while (left <= right)

{

int middle = (left + right) / 2;

if (target < elements[middle])

{

right = middle − 1;

}

else if (target > elements[middle])

{

left = middle + 1;

}

else

{

return middle;

}

}

return −1;

}

int[] vals = { 5, 10, 25, 40, 60, 80, 95 }; int target = 5;

|  |  |  |  |
| --- | --- | --- | --- |
| Pass # | left | right | middle |
| 1 | 0 | 6 | 3 |
| 2 | 0 | 2 | 1 |
| 3 | 0 | 0 | 0 |

4. Assume the code above is changed to “while (left < right)”. What value is returned from the call to binarySearch(vals, 5)? -1\_\_\_\_\_\_\_\_\_\_5. Complete the table below for the following method. Replace each ‘?’ with a value.

// Recursive helper to implement search behavior.  
 private static int binarySearchR(int[] a, int target, int min, int max) {  
 if (min > max) {  
 return -1;  
 }   
 else {  
 int mid = (min + max) / 2;  
 if (a[mid] < target) {   
 return binarySearchR(a, target, mid + 1, max);  
 } else if (a[mid] > target) {   
 return binarySearchR(a, target, min, mid - 1);  
 } else {  
 return mid;   
 }  
 }  
 }

int[] vals = { 5, 10, 25, 40, 60, 80, 95 }; int target = 5; min = 0; max = 6;

|  |  |
| --- | --- |
| Method call | mid |
| binarySearchR(a, 5, 0, 6) | 3 |
| binarySearchR(a, 5, 0, 2) | 1 |
| binarySearchR(a, 5, 0, 0) | 0 |

6. Suppose the following array has been declared:

int[] list = { -2, 8, 13, 22, 25, 25, 38, 42, 51, 103 }

What indexes will be examined as the middle element by a binary search for each of the following target values?

Target Values Indexes

a. 103 \_4, 7, 8, 9\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. 30 \_4, 7, 5, 6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. 8 \_4, 1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. -1 \_4, 1, 0\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. Suppose the following array has been declared:

int[] list = {-10, -5, 0, 5, 10, 20, 30, 40, 50, 60, 70, 100};

What indexes will be examined as the middle element by a binary search for each of the following target values?

Target Values Indexes

1. 40 \_5, 8, 6, 7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. -20 \_5, 2, 0\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. 150 \_5, 8, 10, 11\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. -10 \_5, 2, 0\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. 0 \_5, 2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. 100 \_5, 8, 10, 11\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_