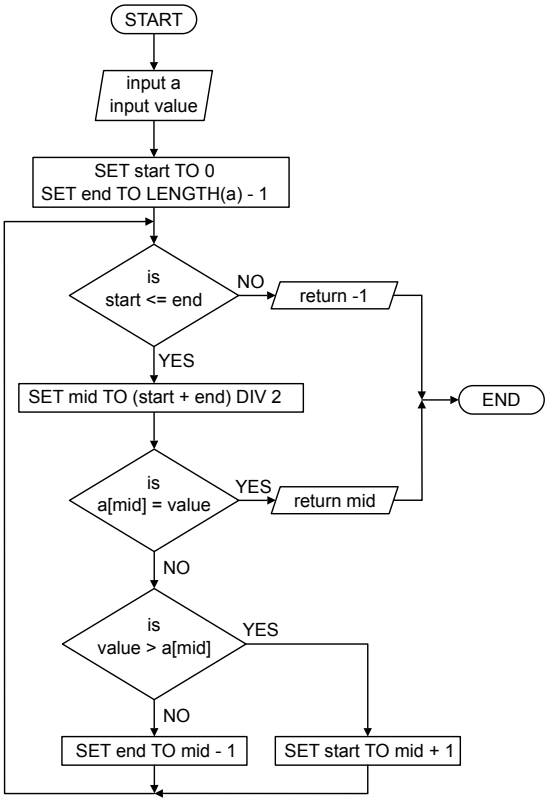
English Name: _____

Worksheet: Binary Search

1. Study the flowchart and code for the *Binary Search* algorithm, then fill in the trace tables to search for the specified value in the given array.




```
1  public static int binarySearch(
2                int[] a, int value) {
3     int start = 0;
4     int end = a.length - 1;
5     while( start <= end ) {
6        int mid = (start+end) / 2;
7        if( a[mid] == value) {
8           return mid;
9        }
10       if( value > a[mid] ) {
11          start = mid + 1;
12       } else {
13          end = mid - 1;
14       }
15    }
16    return -1;
17 }
```

a) Search for `value = 0` in the array `arr = { -5, -1, 0, 3, 9, 15, 21 }`.

line 5		line 7			line 10	final return
start	end	mid	a[mid]	a[mid]==value	value>a[mid]	
0	6	3	3	false	false	
0	2	1	-1	false	true	
2	2	2	0	true		2

b) Search for `value = 13` in the array `arr = { -5, -1, 0, 3, 9, 15, 21 }`.

line 5		line 7			line 10	final return
start	end	mid	a[mid]	a[mid]==value	value>a[mid]	
0	6	3	3	false	true	
4	6	5	15	false	false	
4	4	4	9	false	true	
5	4					-1

Worksheet: Binary Search

2. A teacher has a sorted list of names from a class, as shown below. For each stage, write "`s`" for the start index, "`m`" for the middle index, and "`e`" for the end index in order to identify the stages of a binary search to find the name "`Jackson`" in the list. In order to calculate the middle index, use integer division: `(start+end) DIV 2`. The indices of the array are written above the first stage to help you.

a)

0	1	2	3	4	5	6	7	8	9
Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
s				*m*					*e*

b)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
					s		*m*		*e*

c)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
					s, m	*e*			

d)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
						s, m, e			

e) How many times did the algorithm need to compare two names before it was able to find the name "`Jackson`"?

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3. Use *binary search* to search for the name "`Johnson`" in the same list.

a)

0	1	2	3	4	5	6	7	8	9
Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
s				***m***					*e*

b)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
					s		***m***		*e*

c)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
					s, ***m***	*e*			

d)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
						s, ***m****, e*			

e)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
						e	*s*		

f) How many time would the algorithm need to compare two names before exiting if the list was searched for the name "`Johnson`"?

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4. Use *binary search* to search for "`Linton`" in the same list.

a)

0	1	2	3	4	5	6	7	8	9
Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
s				***m***					*e*

b)

Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
					s		***m***		*e*

c) How many times would the algorithm need to compare two names in order to find the name "`Linton`"?

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