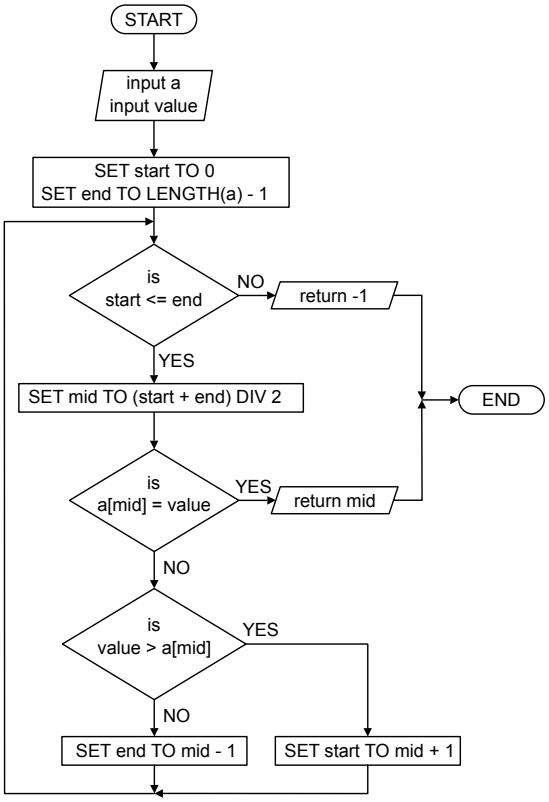
Worksheet: Binary Search

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]	

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]	

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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.

	0	1	2	3	4	5	6	7	8	9
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
a)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
b)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
c)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
d)										

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

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

	0	1	2	3	4	5	6	7	8	9
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
a)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
b)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
c)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
d)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
e)										

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

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

	0	1	2	3	4	5	6	7	8	9
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
a)										
	Azikewe	Bloom	Byrne	Davidson	Gateri	Hinton	Jackson	Linton	Smith	Wall
b)										

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