Linear and binary search

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Overview

MyArray

Searching for some value in an array
- Linear Search
- Binary Search

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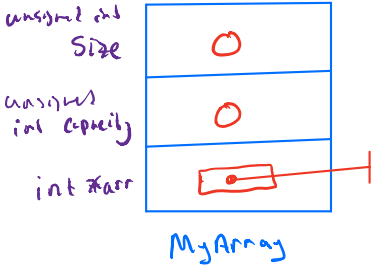
- Linear Search
- Binary Search

MyArray

```
1  #ifndef MYARRAY_H
2  #define MYARRAY_H
3  struct MyArray {
4      int *arr = nullptr;
5      unsigned int capacity = 0; // no elements can store
6      unsigned int size = 0; // no elements currently held
7  };
8  #endif
```



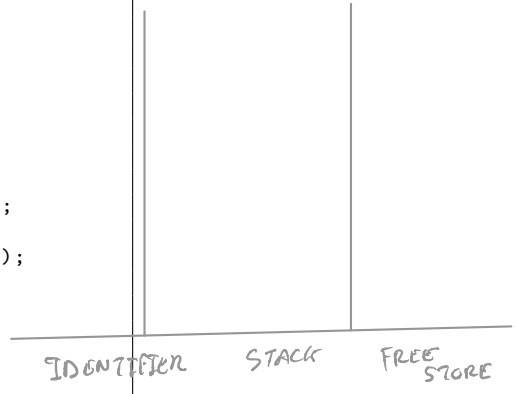
Overview

MyArray

Searching for some value in an array
- Linear Search
- Binary Search

Setting-up

```
 1  #include <iostream>
 2  #include "MyArray.h"
 3  #include "linearSearch.h"
 4  #include "binarySearch.h"
 5
 6  using namespace std;
 7
 8  int main()
 9  {
10      MyArray ma1;
11      ma1.arr = new int[7];
12      ma1.capacity = 7;
13      ma1.size = 7;
14      for (unsigned int i = 0; i < ma1.size; ++i)
15          ma1.arr[i] = i * 10;
16
17      unsigned int idxofvalue = linearSearch(ma1, 20);
18
19      unsigned int idxofvalue2 = binarySearch(ma1, 20);
20
21      delete [] ma1.arr;
22
23      return 0;
24  }
```



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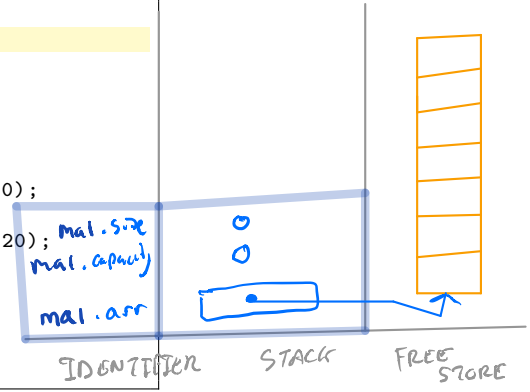

Setting-up

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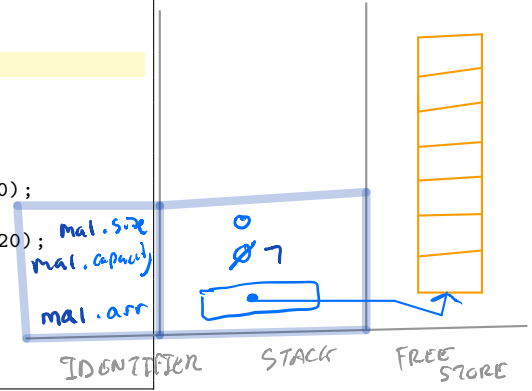

Setting-up

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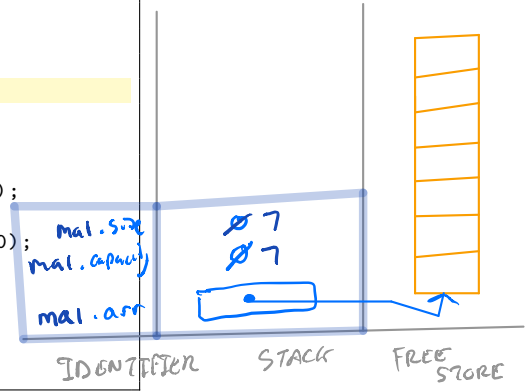

Setting-up

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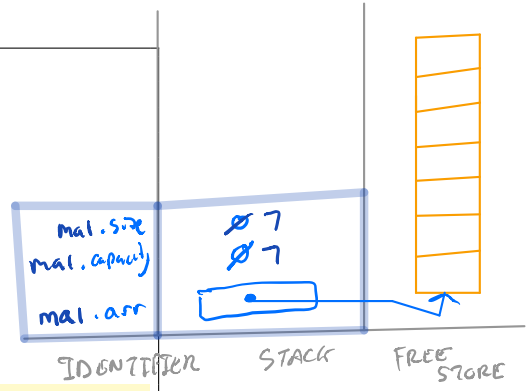

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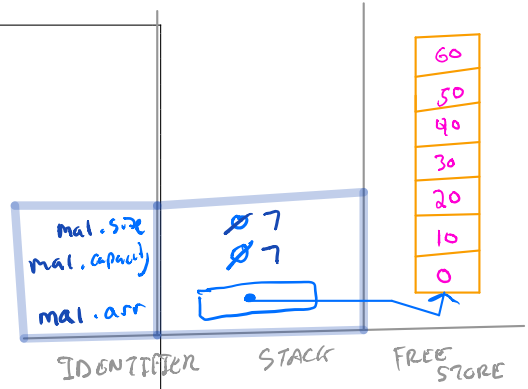

Overview

MyArray

Searching for some value in an array

- Linear Search
- Binary Search

Calling our linearSearch function

```
 1  #include <iostream>
 2  #include "MyArray.h"
 3  #include "linearSearch.h"
 4  #include "binarySearch.h"
 5
 6  using namespace std;
 7
 8  int main()
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10      MyArray ma1;
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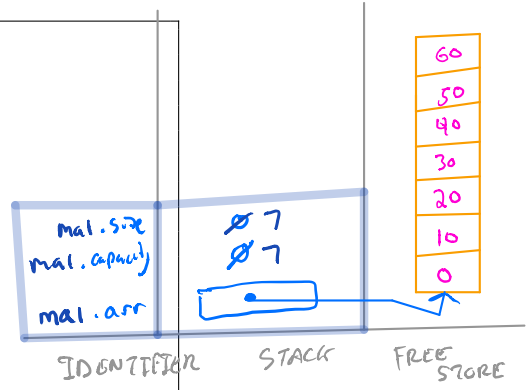

linearSearch()

```
1  #include "linearSearch.h"
2
3  int linearSearch(MyArray const &mya, int valSearchFor)
4  {
5      for (unsigned int i = 0; i < mya.size; ++i) {
6          if (mya.arr[i] == valSearchFor)
7              return i;
8      }
9      return -1;
10 }
```

linearSearch()

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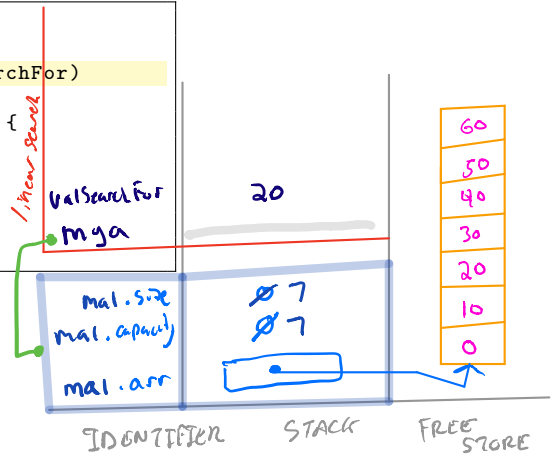

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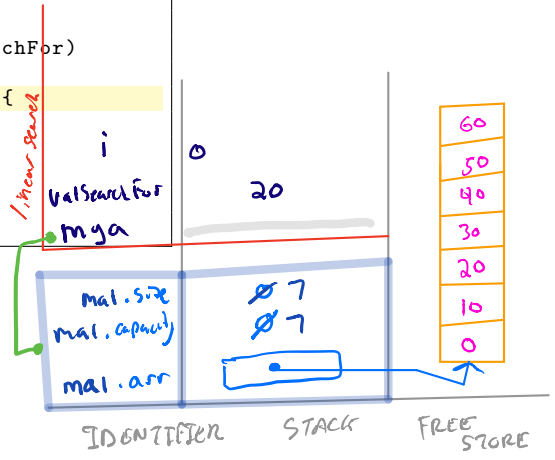

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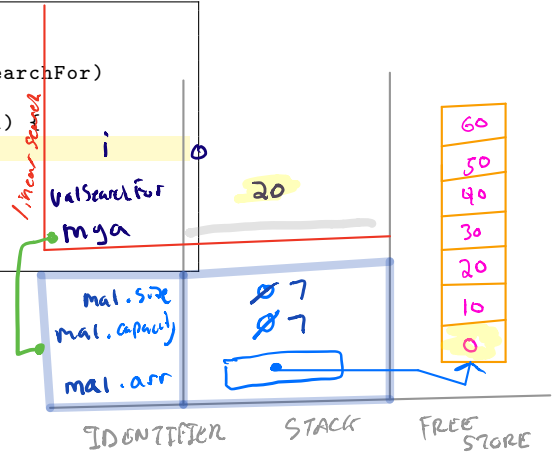

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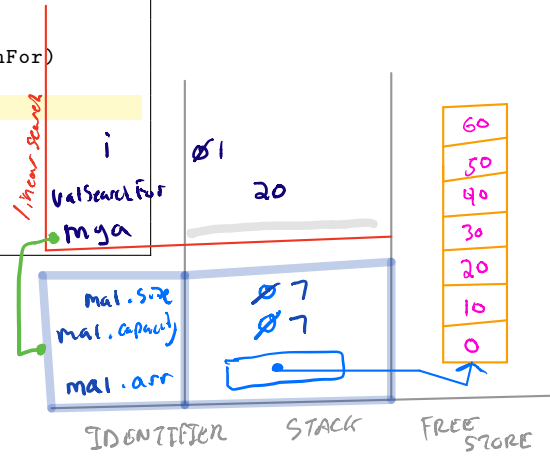

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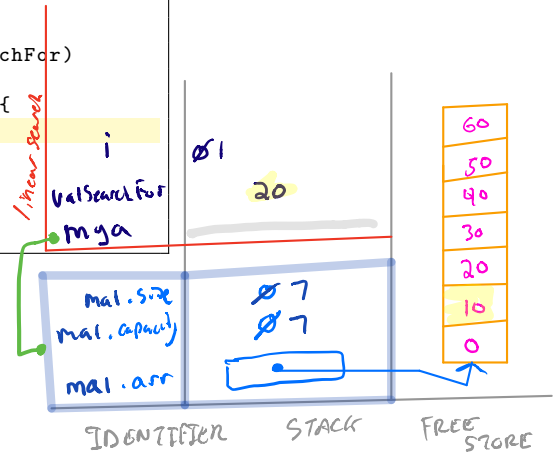

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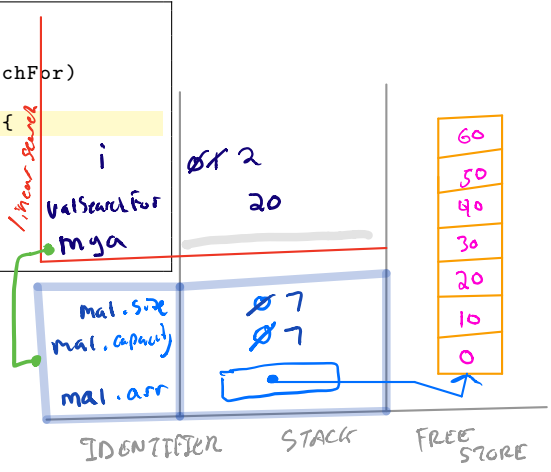

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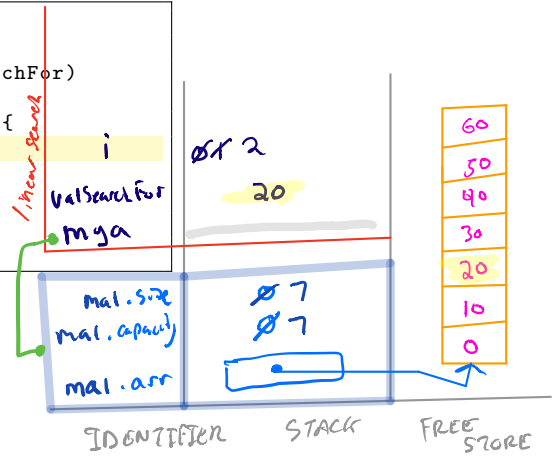

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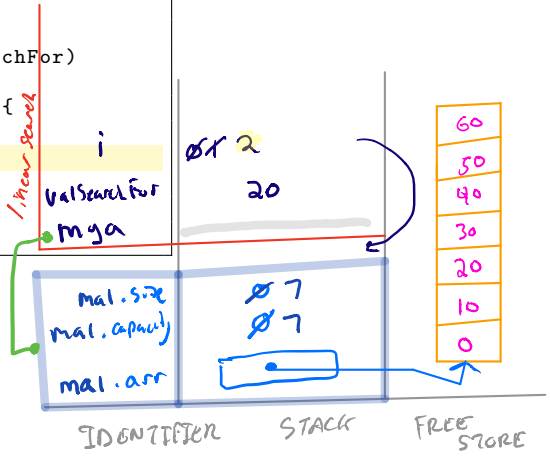

Returned to `main`

```
1  #include <iostream>
2  #include "MyArray.h"
3  #include "linearSearch.h"
4  #include "binarySearch.h"
5
6  using namespace std;
7
8  int main()
9  {
10     MyArray ma1;
11     ma1.arr = new int[7];
12     ma1.capacity = 7;
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14     for (unsigned int i = 0; i < ma1.size; ++i)
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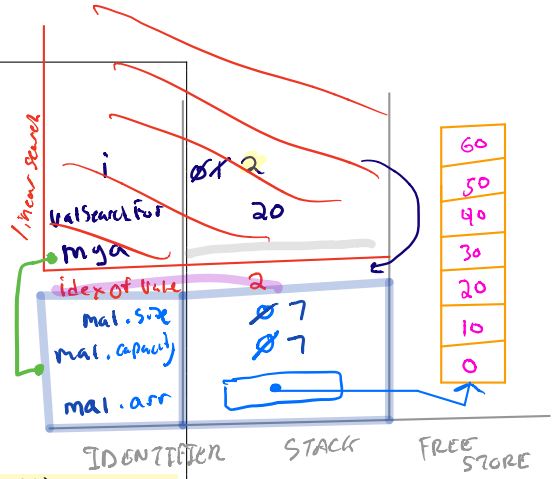

Overview

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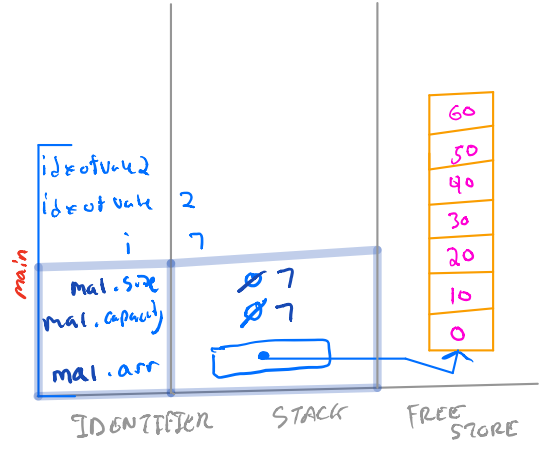
- Binary Search



* more complete picture of main's activation record

Binary Search

- Requirement: data is sorted!

Calling our binary search function

```
1  #include <iostream>
2  #include "MyArray.h"
3  #include "linearSearch.h"
4  #include "binarySearch.h"
5
6  using namespace std;
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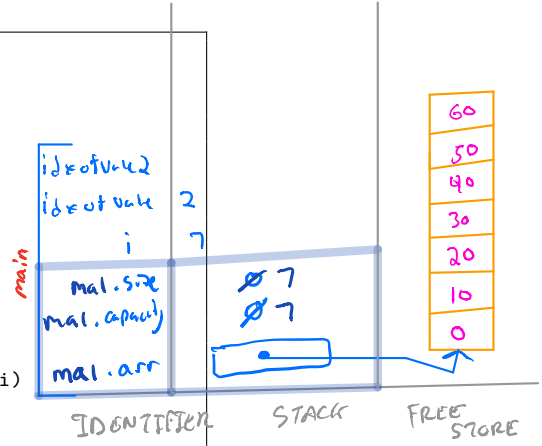
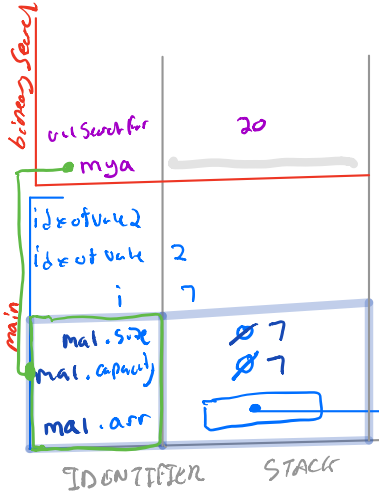


binarySearch()

```
1  #include "binarySearch.h"
2  #include <iostream>
3
4  int binarySearch(MyArray const &mya, int valSearchFor)
5  {
6      /* return (any) position if valSearchFor is in sorted
           mya.arr[0..size-1] or -1 if valSearchFor is not
           present */
7      unsigned int lowerBound = 0;
8      unsigned int upperBound = mya.size - 1;
9      while (lowerBound <= upperBound) {
10         unsigned int midpt = (lowerBound + upperBound) / 2;
11         if (mya.arr[midpt] < valSearchFor)
12             lowerBound = midpt + 1;
13         else if (mya.arr[midpt] == valSearchFor)
14             return midpt;
15         else /* mya.arr[midpt] > valSearchFor */
16             upperBound = midpt - 1;
17     }
18     return -1;
19 }
```

binarySearch()

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1  #include "binarySearch.h"
2  #include <iostream>
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4  int binarySearch(MyArray const &mya, int valSearchFor)
5  {
6      /* return (any) position if valSearchFor is in sorted
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17     }
18     return -1;
19 }
```
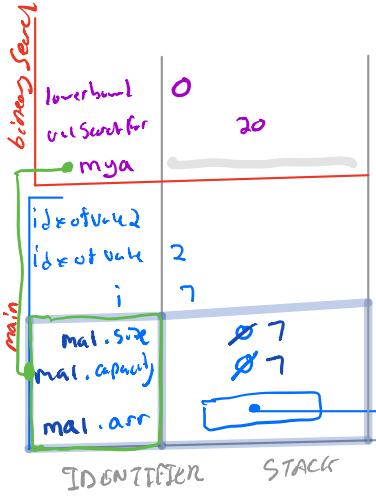

60
50
40
30
20
10
0

binarySearch()

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4  int binarySearch(MyArray const &mya, int valSearchFor)
5  {
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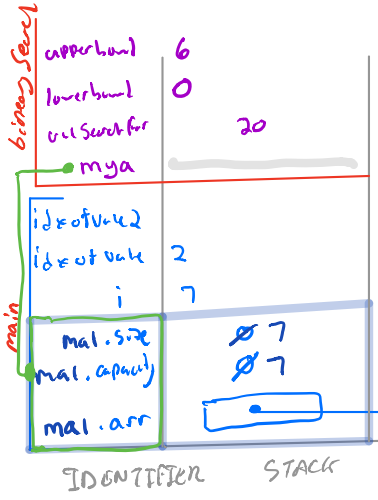
60 50 40 30 20 10 0

binarySearch()




```
1  #include "binarySearch.h"
2  #include <iostream>
3
4  int binarySearch(MyArray const &mya, int valSearchFor)
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6      /* return (any) position if valSearchFor is in sorted
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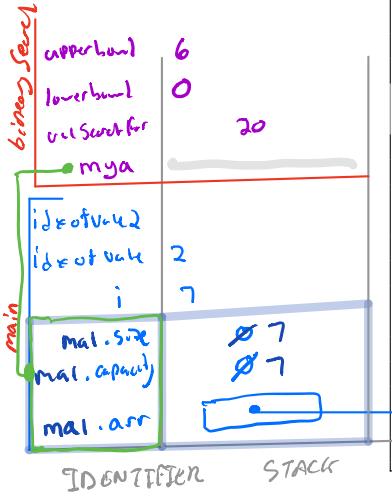
STORE

binarySearch()

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60 50 40 30 20 10 0

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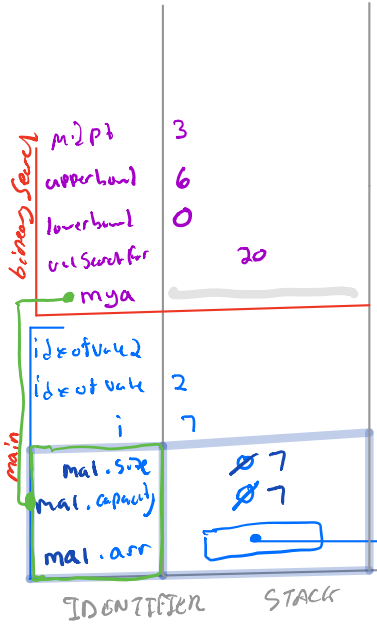


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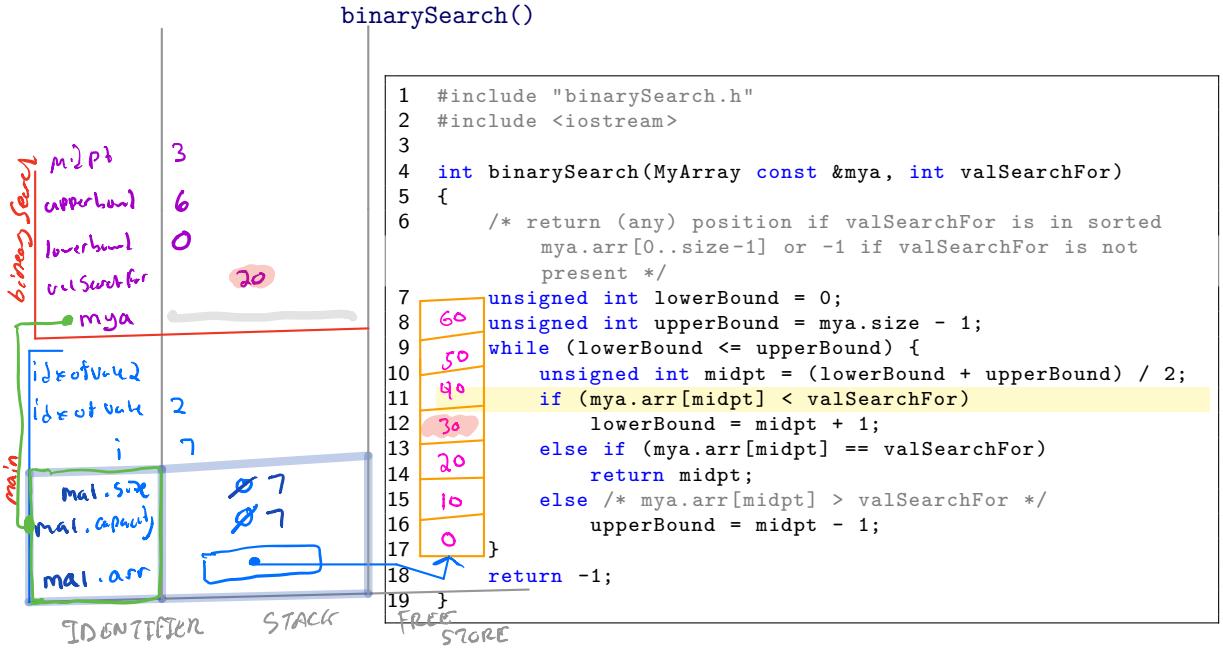


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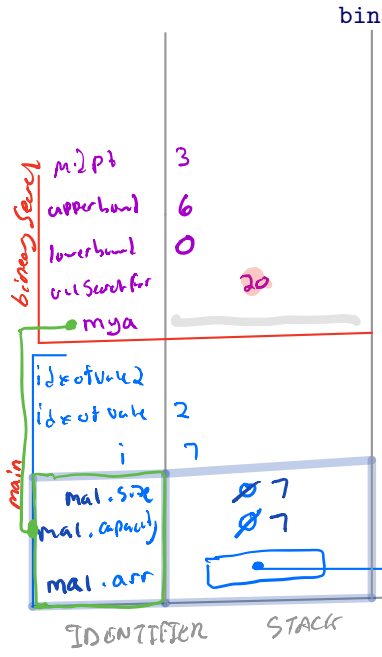


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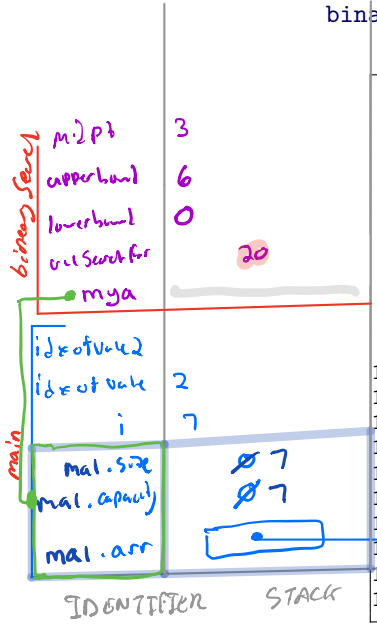
binarySearch()

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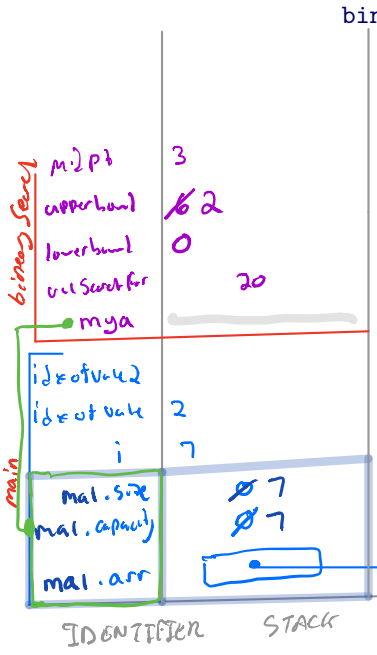


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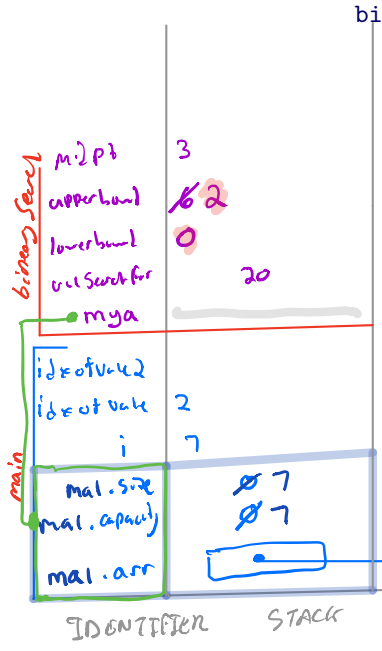


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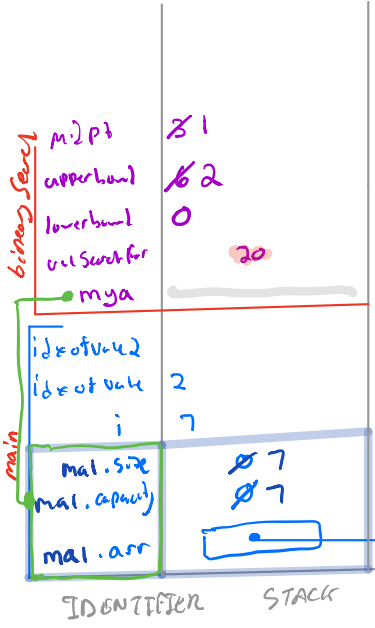
binarySearch()

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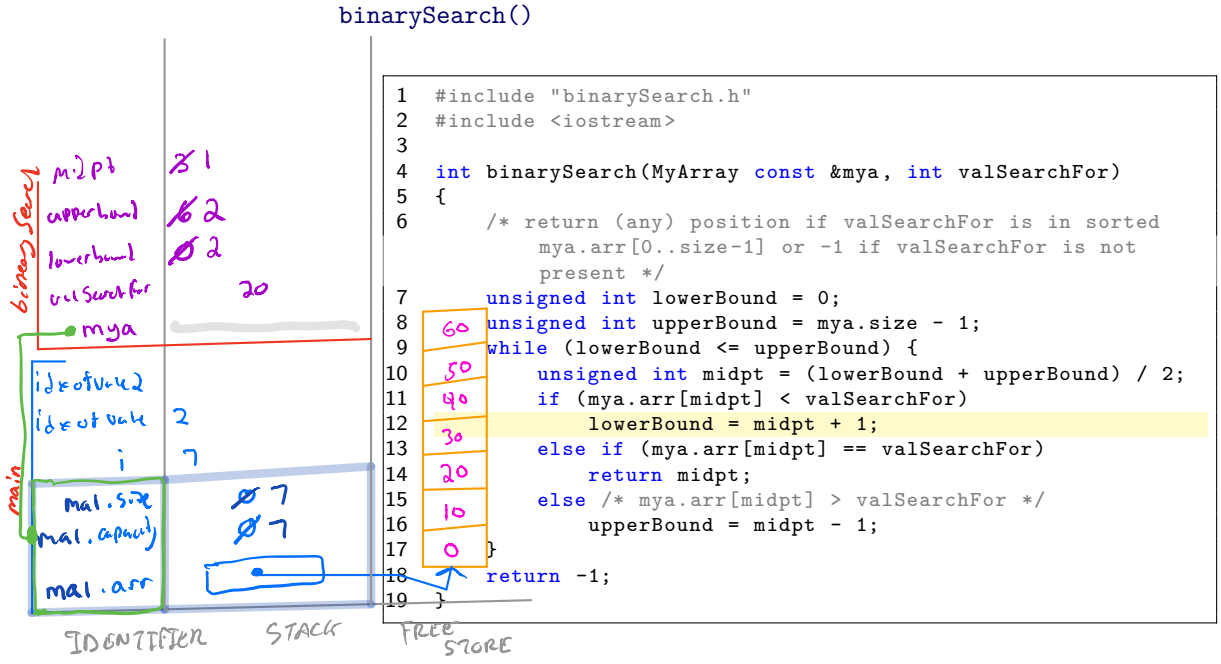


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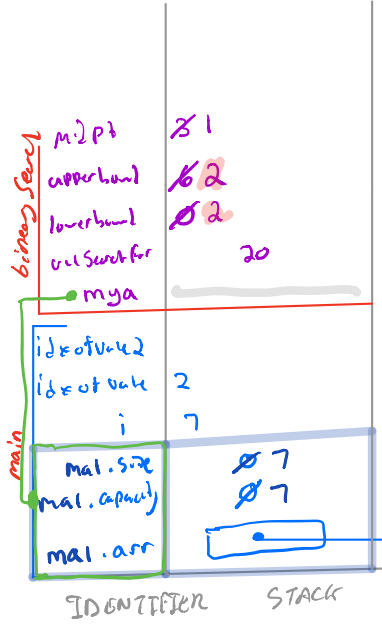


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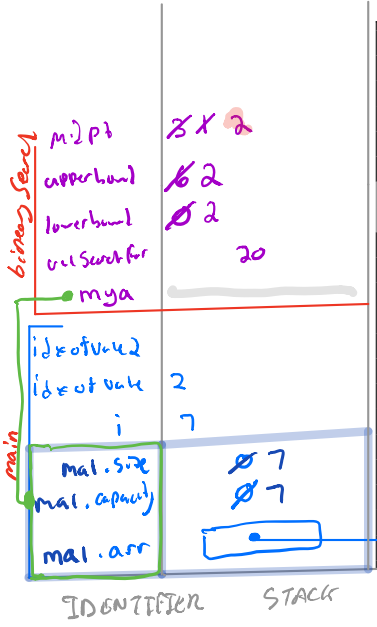


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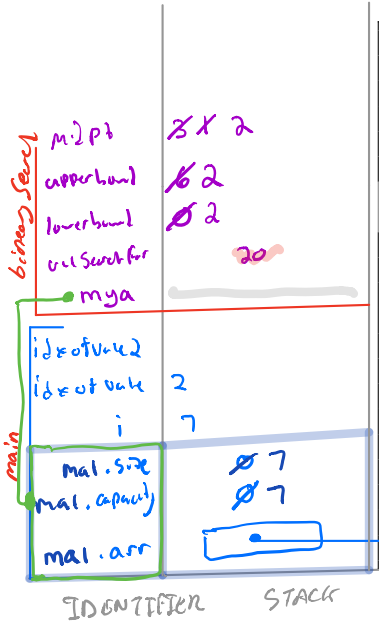


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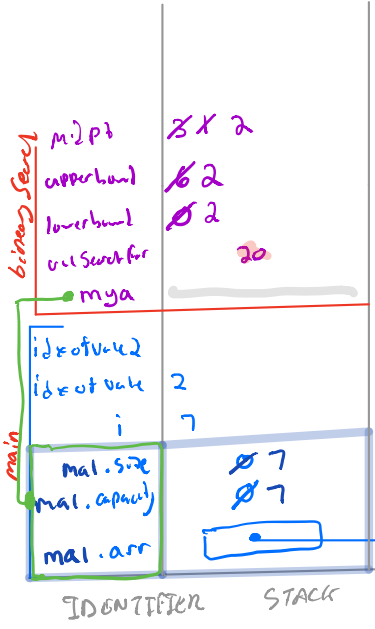


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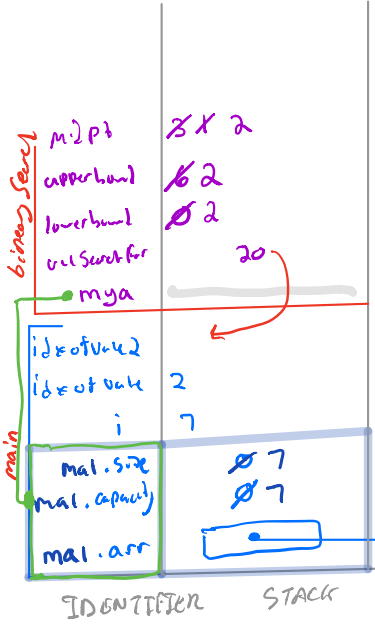


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Returned to main

```
1  #include <iostream>
2  #include "MyArray.h"
3  #include "linearSearch.h"
4  #include "binarySearch.h"
5
6  using namespace std;
7
8  int main()
9  {
10     MyArray ma1;
11     ma1.arr = new int[7];
12     ma1.capacity = 7;
13     ma1.size = 7;
14     for (unsigned int i = 0; i < ma1.size; ++i)
15         ma1.arr[i] = i * 10;
16
17     unsigned int idxofvalue = linearSearch(ma1, 20);
18
19     unsigned int idxofvalue2 = binarySearch(ma1, 20);
20
21     delete [] ma1.arr;
22
23     return 0;
24 }
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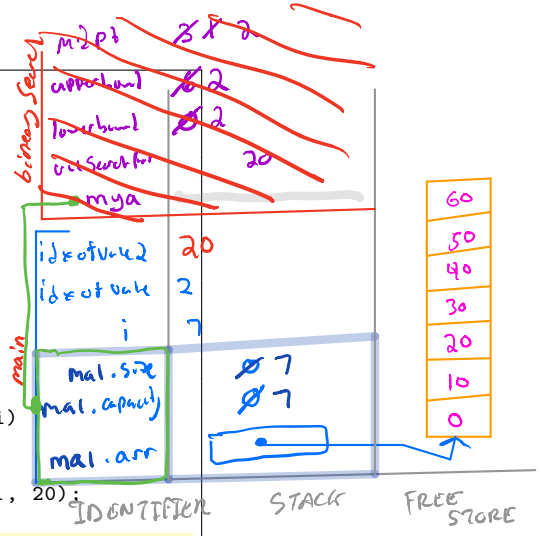

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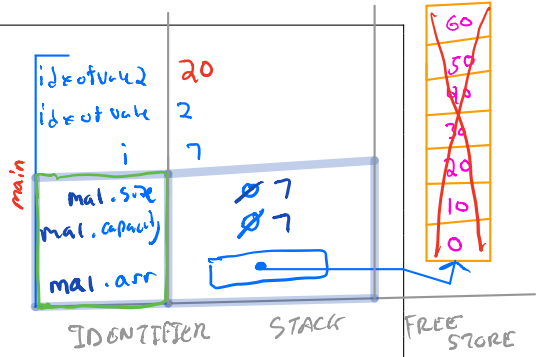

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