

CS1022 Tutorial #5

Sample Exam Question

Binary search is a well-known algorithm for locating a value in a sorted array of values. It may be expressed in pseudo-code form as follows:

```
int bSrch(array, val, low, high)
{
    if (high < low) {
        // not found, return index -1
        result = -1;
    }
    else {
        // find index of middle element
        midIdx = low + ((high - low) / 2);
        midVal = array[midIdx];

        if (midVal > val) {
            // value could only be in lower half
            result = bSrch(array, val, low, midIdx - 1);
        }
        else if (midVal < val) {
            // value could only be in upper half
            result = bSrch(array, val, midIdx + 1, high);
        }
        else {
            // found value, return index
            result = midIdx;
        }
    }
}
```

- (a) Design a suitable interface for the bSrch subroutine.
- (b) Using the pseudo-code algorithm provided, write an ARM Assembly Language subroutine that implements binary search.
- (c) Write an ARM Assembly Language program to test your subroutine.
- (d) Given the sorted sequence of values below, list the parameter values passed to each recursive invocation of your bSrch subroutine resulting from an initial invocation of:

bSrch(array, 10, 0, 11)

2, 4, 6, 7, 10, 12, 13, 15, 17, 19, 20, 25

- (e) Given the same sequence of values and the same initial invocation of bSrch, illustrate the effect of each PUSH and POP operation on the system stack.