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CSE 541T HW1

Question 1,

a, linear search:

```
1,      for i =0 to A.length-1
2,              now = A[i]
3,              if v = now
4,                      return i
5,              end if
6,      end for
7,      return NIL
```

Loop invariants:

Initialization:

We start by showing that the loop invariant holds before the first loop iteration, when i=0. The now =A[0] which is the first item. If the *v* = A[0], the algorithm will return 0.
Else, if the array length = 1, it will return NIL, or it will go to the first iteration of the loop. So that shows the loop invariant holds prior to the first iteration of the loop.

Maintenance:

The body of the for loop will go through A[1], A[2]…A[A.length-3], A[A.length-2], A[A.length-1]. If A[x] != *v*, then the algorithm will check if A[x+1] =*v* or not. At any point, if A[x]= *v*(x< A.length-1), the algorithm will return the value of x as index, or it will go to the next iteration of loop. Therefore, the loop variant holds until the algorithm goes to the last position of the array which is A[A.length-1].

Termination:

Finally, if the algorithm finds any x (x means the index, and only the first x) that makes A[x]= *v*, it will terminate and return the value of x. Or after comparing A[A.length-1] with v, if the algorithm go through all the position of the array and doesn't find any x that holds A[x] = *v*, it will return NIL as line 7, we can say there isn't any elements that equals to v in the array A. Hence, the algorithm is correct.