

## Algorithms: Quiz Two

1. Suppose that we run the radix sort algorithm in base 10 on the following 8-element array.  $A[1] = 672, A[2] = 317, A[3] = 712, A[4] = 372, A[5] = 127, A[6] = 635, A[7] = 212, A[8] = 517$ . What is the sequence of array indices after two passes (i.e. sorting based on the last two digits)?
2. Recall that in the selection algorithm, we partitioned the elements into groups of size five to find an approximate median. Suppose instead that we partition the elements into groups of size seven. What is the recurrence relation for the time complexity of this modified selection algorithm?
3. Consider a randomized version of binary search, in which the input is an array  $A[1, 2, \dots, n]$  of integers such that  $A[1] < A[2] < \dots < A[n]$  and another integer  $x$ . It is given that  $x = A[k]$  for some unknown  $k$  and the goal is to find  $k$ .

Suppose that we modify the binary search algorithm for this: in a search range  $A[first, last]$ , instead of comparing  $x$  with the middle element (i.e.  $A[(first+last)/2]$ ), we pick a random index  $i \in [first, last]$  and compare  $x$  with  $A[i]$ . If  $x = A[i]$ , we return  $i$ ; if  $x < A[i]$ , our next search interval is  $(first, i - 1)$  and if  $x > A[i]$ , our next search interval is  $(i + 1, last)$ .

Let  $1 \leq j < k$ . What is the probability that  $x$  is compared with  $A[j]$  during an execution of this algorithm?