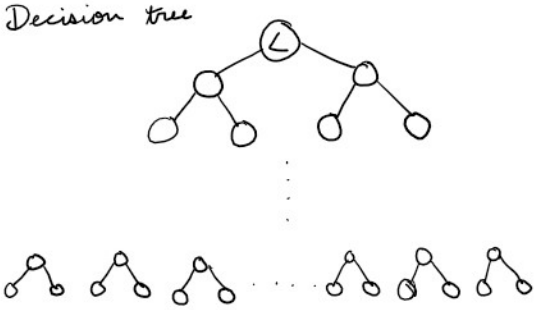
1/23

Thursday, January 23, 2020 9:03 AM

- Comparison Based Sorting Lower Bound

Decision tree



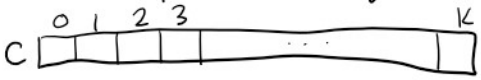
at least $n!$ leaves

Height is at least $\lg(n!)$ (Stirling's Approximation $\rightarrow \lg(n!) \approx n \lg n$)

No comparison based sorts can have a worst case better than $\Omega(n \lg n)$

- Counting Sort

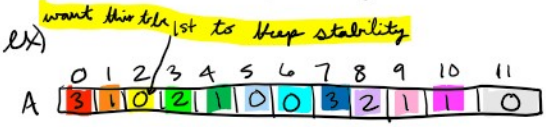
assume input are integers in range 0...K



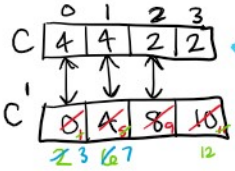
initialize all elements of array to 0:

```
For int i= ; i<M; i++
    C[A[i]]++;
```

- (X) want this to be 1st to keep stability



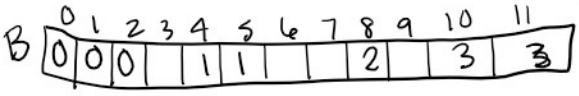
ordered



There are four 0's, four 1's, two 2's, and two 3's

0 starts at index 0, 1 starts at index 4, 2 starts at index 8, 3 starts at index 10

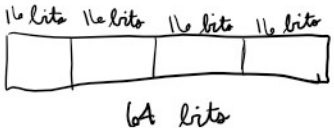
```
For i=0 to n-1
    B[C'[A[i]]] = A[i]
    C'[A[i]]++;
```



O(n) counting and moving

O(K) for computing C'

O(n+K)

- 

4 passes LSB to MSB

- 

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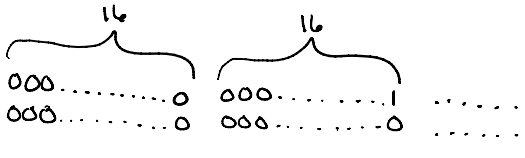

← appears first b/c of stability (maintain order)

Radix sort

- ex) 194
  321
  817
  759
  593
  210
  466
  307
  282
  197
  385

Apply counting sort on the least significant digit:

210	middle digit: 307	last digits: 194
321	210	197
282	817	210
593	321	282
194	759	307
385	466	321
466	282	385
817	593	466
307	194	593
197	197	759
759		817

Completely Ordered!