http://algs4.cs.princeton.edu

2.3 QUICKSORT DEMO

Quicksort

Basic plan.

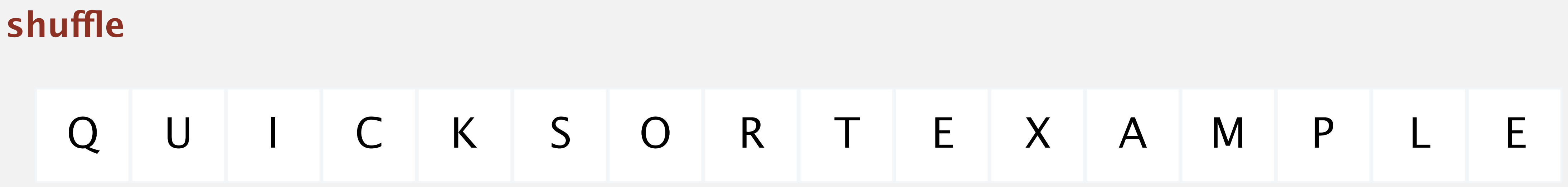
input

Q	U	I	C	K	S	O	R	T	E	X	A	M	P	L	E

Quicksort

Basic plan.

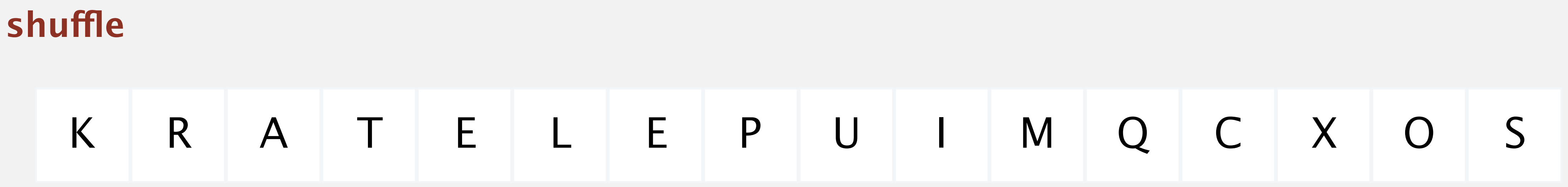
- Shuffle the array.



Quicksort

Basic plan.

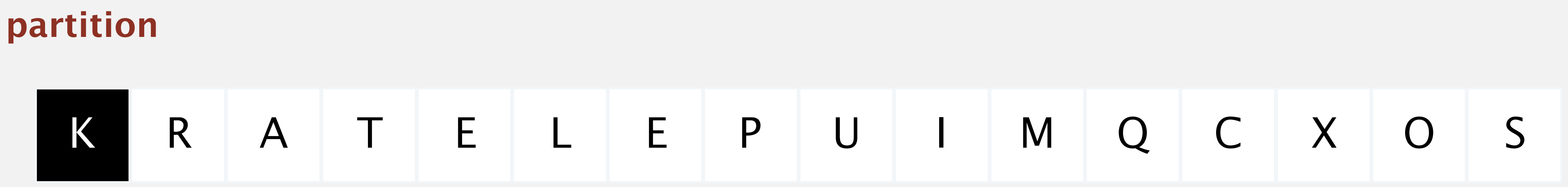
- Shuffle the array.



Quicksort

private static int partition(Comparable[] a, int lo, int hi){...}

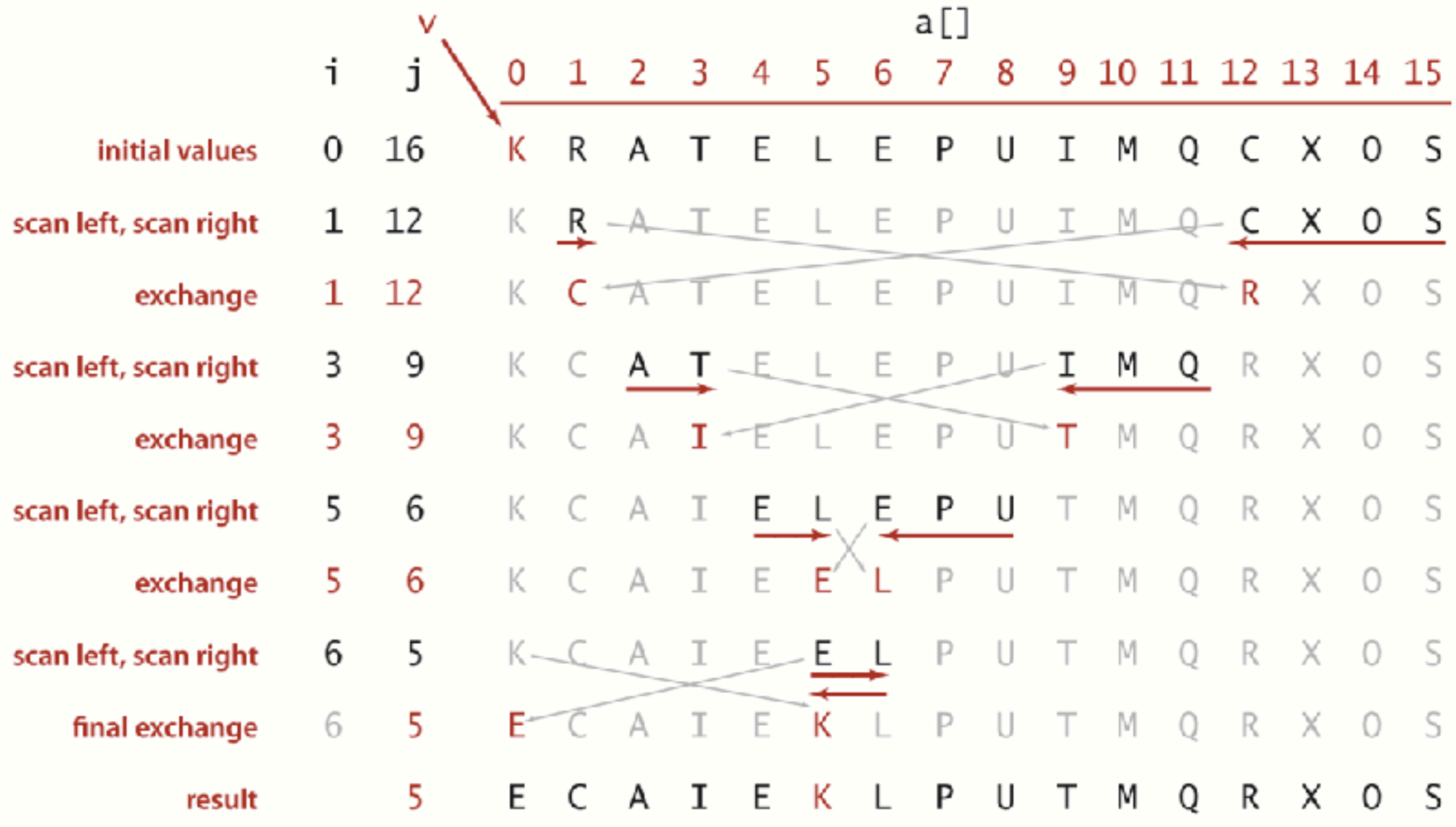
- Initially, a -> array to sort
  - lo -> 0
  - hi -> a.length - 1 (15)
  - partition item = a[lo] = a[0] = “K”



Partition Algorithm: Java

```java
private static int partition(Comparable[] a, int lo, int hi)
{  // Partition into a[lo..i-1], a[i], a[i+1..hi].
   int i = lo, j = hi+1;              // left and right scan indices
   Comparable v = a[lo];              // partitioning item
   while (true)
   {  // Scan right, scan left, check for scan complete, and exchange.
      while (less(a[++i], v)) if (i == hi) break;
      while (less(v, a[--j])) if (j == lo) break;
      if (i >= j) break;
      exch(a, i, j);
   }
   exch(a, lo, j);         // Put v = a[j] into position
   return j;               // with a[lo..j-1] <= a[j] <= a[j+1..hi].
}
```

Finding the final position of "K"



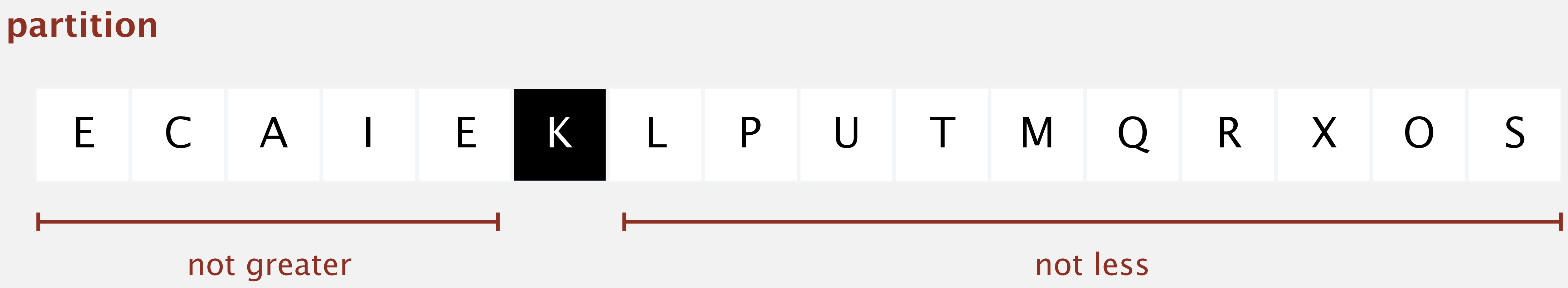
	i	j	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
initial values	0	16	K	R	A	T	E	L	E	P	U	I	M	Q	C	X	O	S
scan left, scan right	1	12	K	R	A	T	E	L	E	P	U	I	M	Q	C	X	O	S
exchange	1	12	K	C	A	T	E	L	E	P	U	I	M	Q	R	X	O	S
scan left, scan right	3	9	K	C	A	T	E	L	E	P	U	I	M	Q	R	X	O	S
exchange	3	9	K	C	A	I	E	L	E	P	U	T	M	Q	R	X	O	S
scan left, scan right	5	6	K	C	A	I	E	L	E	P	U	T	M	Q	R	X	O	S
exchange	5	6	K	C	A	I	E	E	L	P	U	T	M	Q	R	X	O	S
scan left, scan right	6	5	K	C	A	I	E	E	L	P	U	T	M	Q	R	X	O	S
final exchange	6	5	E	C	A	I	E	K	L	P	U	T	M	Q	R	X	O	S
result		5	E	C	A	I	E	K	L	P	U	T	M	Q	R	X	O	S

Partitioning trace (array contents before and after each exchange)

Quicksort

Basic plan.

- Shuffle the array.
- Partition so that, for some `j`
  - entry `a[j]` is in place
  - no larger entry to the left of `j`
  - no smaller entry to the right of `j`



Quicksort

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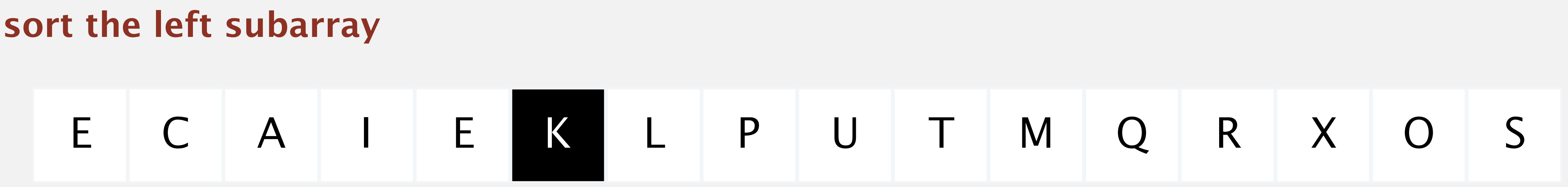
- Sort each subarray recursively.



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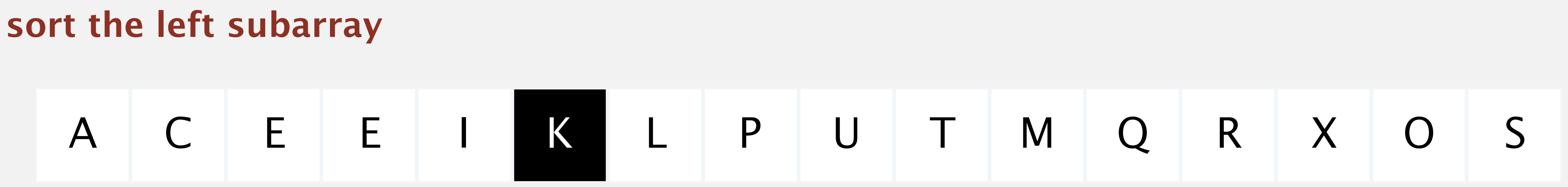

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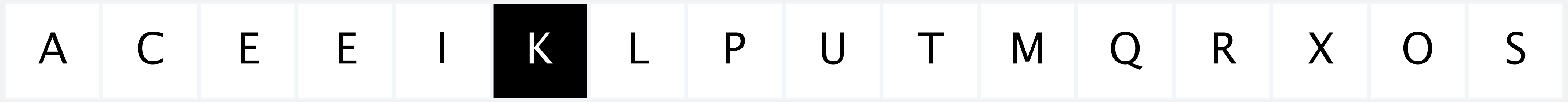
sort the right subarray



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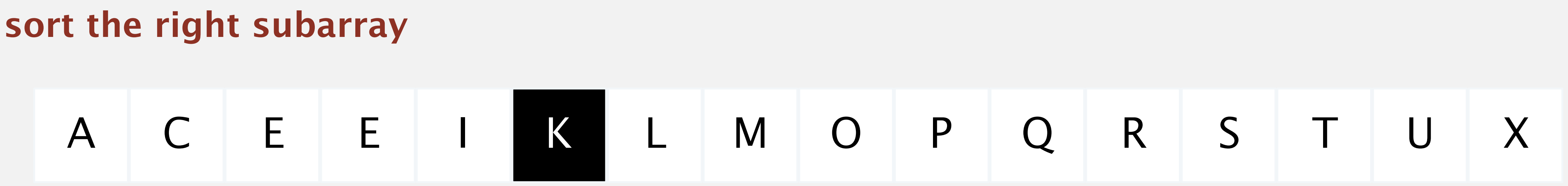

Quicksort

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- Shuffle the array.
- Partition so that, for some `j`
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- Sort each subarray recursively.

sorted array

A	C	E	E	I	K	L	M	O	P	Q	R	S	T	U	X