

let $n = \text{length of list}$

a_1, \dots, a_n the list itself

Ex. $n = 6$: a_1 a_2 a_3 a_4 a_5 a_6
 7 9 5 0 4 3

RIGHTMOST
INDEX IN
UNSORTED
SEC.

7	9	5	0	4	3		<u>6</u>
7	3	5	0	4	9		5
4	3	5	0	7	9		4
4	3	0	5	7	9		3
0	3	4	5	7	9		2
0	3	4	5	7	9		1

Ex. $n=8$: a_1 a_2 a_3 a_4 a_5 a_6 a_7 a_8
2 5 1 3 7 8 4 6

2 5 1 3 7 8 4 6 | $\frac{R}{8}$

2 5 1 3 7 6 4 | 8 7

2 5 1 3 4 6 | 7 8 6

2 5 1 3 4 | 6 7 8 5

2 4 1 3 | 5 6 7 8 4

2 3 1 | 4 5 6 7 8 3

2 1 | 3 4 5 6 7 8 2

1 | 2 3 4 5 6 7 8 1

Selection Sort

- 1.) $R \leftarrow n$
- 2.) while $R \geq 2$
- * 3.) find index i of max. elt. in unsorted sec.
- * 4.) swap a_i with a_R
- 5.) $R \leftarrow R - 1$
- 6.) stop

Refinement of step 3:

- 3.1) $i \leftarrow 1$
- 3.2) for $j \leftarrow 2$ to R
- 3.3) if $a_j > a_i$ ← Basic OP.
- 3.4) $i \leftarrow j$

Refinement of step 4

4.1) $temp \leftarrow a_i$

4.2) $a_i \leftarrow a_R$

4.3) $a_R \leftarrow temp$

Ex.

	<u>a_i</u>	<u>a_R</u>	<u>temp</u>
	6	7	?
4.1)	6	7	6
4.2)	7	7	6
4.3)	7	6	6

Exercise

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Re-write Selection Sort with refinements, renumbering as needed.

EXERCISE:

~~Trace~~ Previous examples, check that pseudo-code operates as expected.

Run Time

BASIC OPERATION: comparison of 2 elements in the list.

Count # of times 3.3 is executed in best, worst, & avg. cases.

NOTE: 3.3 is inside 2 loops

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• Outer while loop controlled by R

• Inner for loop controlled by j

3.3 is executed once on each iteration of inner for loop.

<u>outer</u>	<u>inner</u>	<u>#comp</u>
$R=n$	$2 \leq j \leq n$	$n-1$
$R=n-1$	$2 \leq j \leq n-1$	$n-2$
$R=n-2$	$2 \leq j \leq n-2$	$n-3$
\vdots	\vdots	\vdots
$R=3$	$2 \leq j \leq 3$	2
$R=2$	$2 \leq j \leq 2$	1

Total # of comparisons =

$$1 + 2 + 3 + \dots + (n-3) + (n-2) + (n-1)$$

Recall

$$1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$$

So

$$\begin{aligned} 1 + 2 + 3 + \dots + (n-1) &= \frac{(n-1)((n-1)+1)}{2} \\ &= \frac{n(n-1)}{2} \end{aligned}$$

$$\# \text{ comp} = \frac{n(n-1)}{2} = \frac{1}{2}n^2 - \frac{1}{2}n$$

In best, worst, & avg. case.

If we had counted peripheral operations, we would have

$$\text{Cost} = an^2 + bn + c$$