

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
10	18	2	14	3	12	1			

Slides by **Sean Szumlanski**
for **CS106B**, Programming Abstractions

Winter 2024

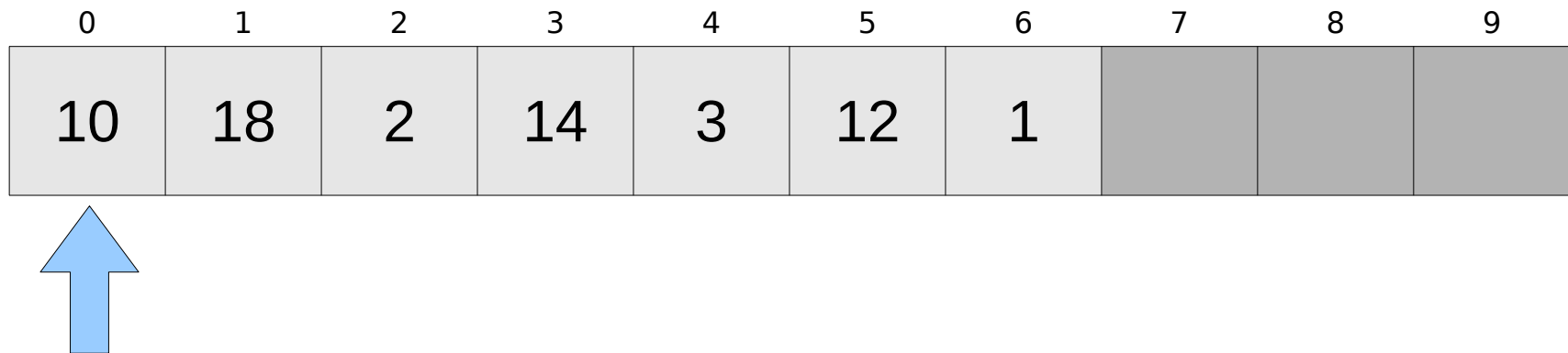
Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
10	18	2	14	3	12	1			

Selection Sort

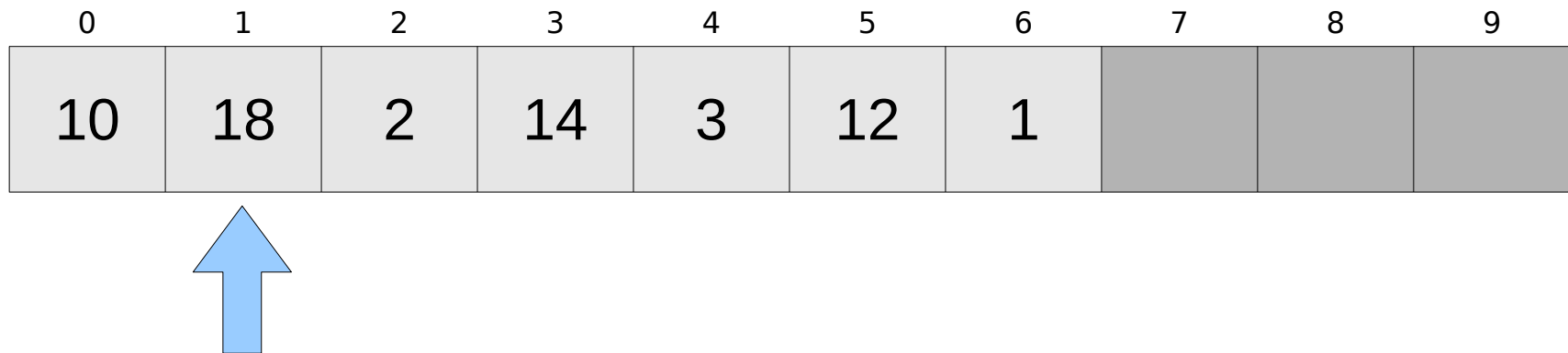
(select the smallest element)



Smallest element seen (so far): 10 (at index 0)

Selection Sort

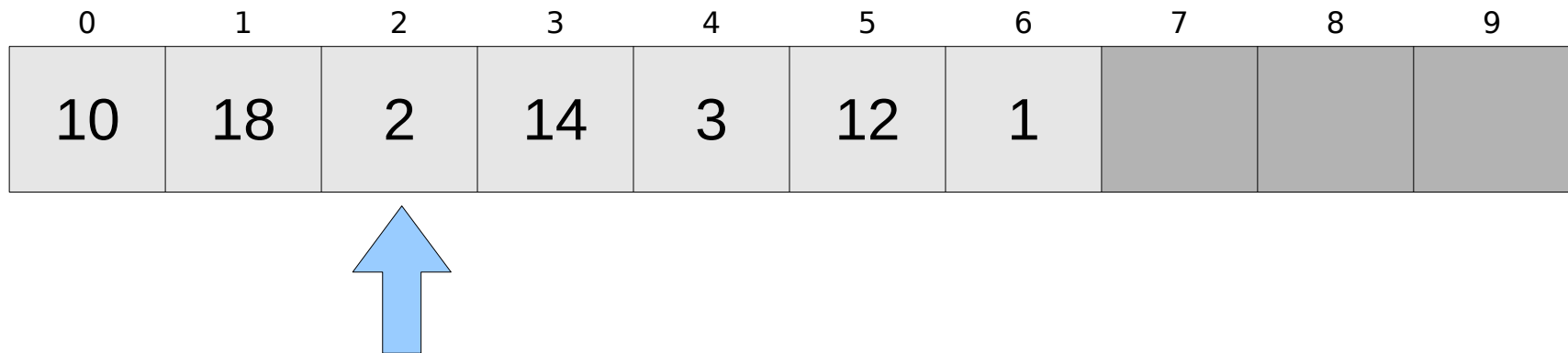
(select the smallest element)



Smallest element seen (so far): 10 (at index 0)

Selection Sort

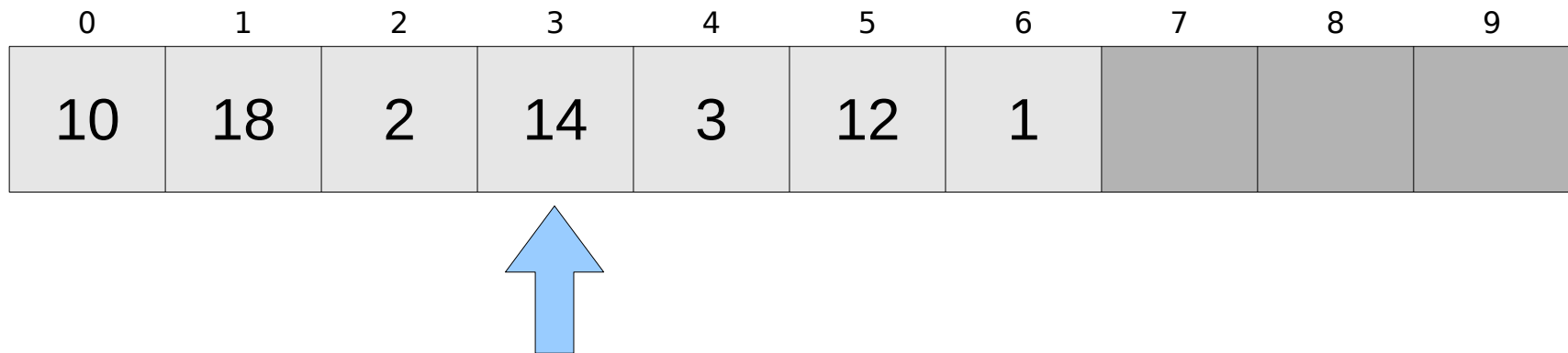
(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

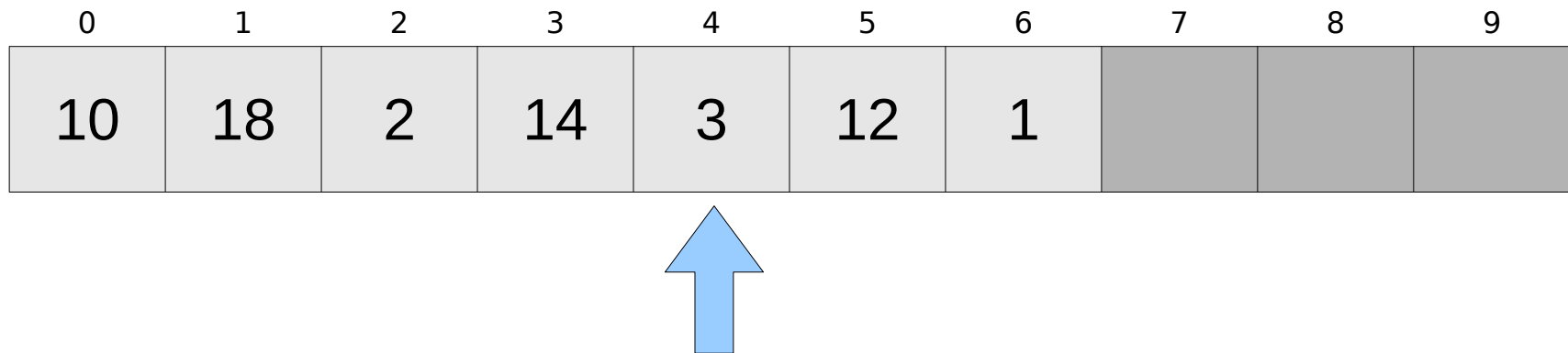
(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

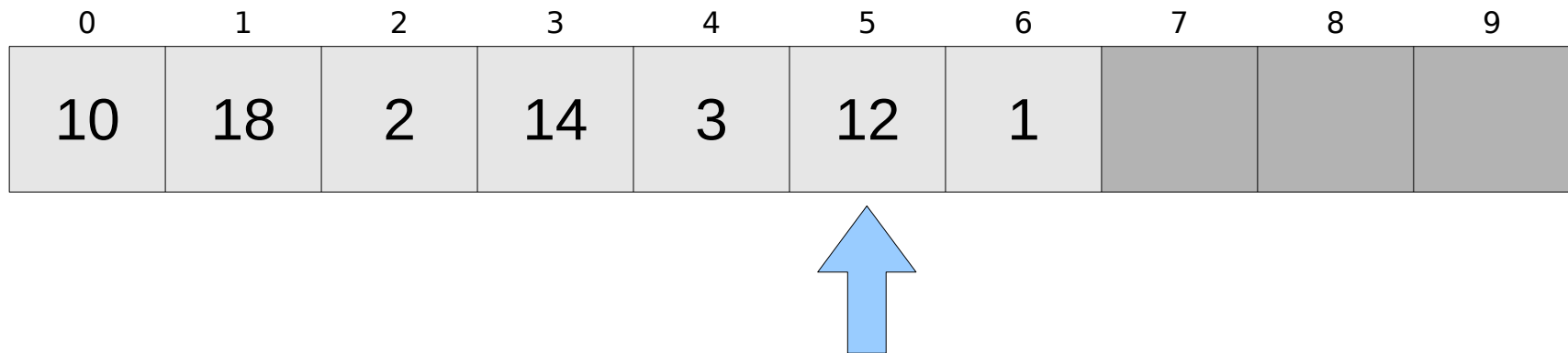
(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

(select the smallest element)

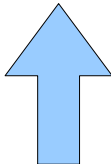


Smallest element seen (so far): 2 (at index 2)

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
10	18	2	14	3	12	1			



Smallest element seen (so far): 1 (at index 6)

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
10	18	2	14	3	12	1			

We've found the **smallest element** in the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
10	18	2	14	3	12	1			

We've found the **smallest element** in the vector.

Notice everything is **unsorted** so far.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
10	18	2	14	3	12	1			

We've found the **smallest element** in the vector.

Notice everything is **unsorted** so far.

Swap that smallest element into the **leftmost position** of the **unsorted** portion of the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	18	2	14	3	12	10			

We've found the **smallest element** in the vector.

Notice everything is **unsorted** so far.

Swap that smallest element into the **leftmost position** of the **unsorted** portion of the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	18	2	14	3	12	10			

We've found the **smallest element** in the vector.

Notice everything is **unsorted** so far.

Swap that smallest element into the **leftmost position** of the **unsorted** portion of the vector.

Mark that position as part of a **sorted portion** of the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	18	2	14	3	12	10			

We've found the **smallest element** in the vector.

Notice everything is **unsorted** so far.

Swap that smallest element into the **leftmost position** of the **unsorted** portion of the vector.

Mark that position as part of a **sorted portion** of the vector.

Selection Sort

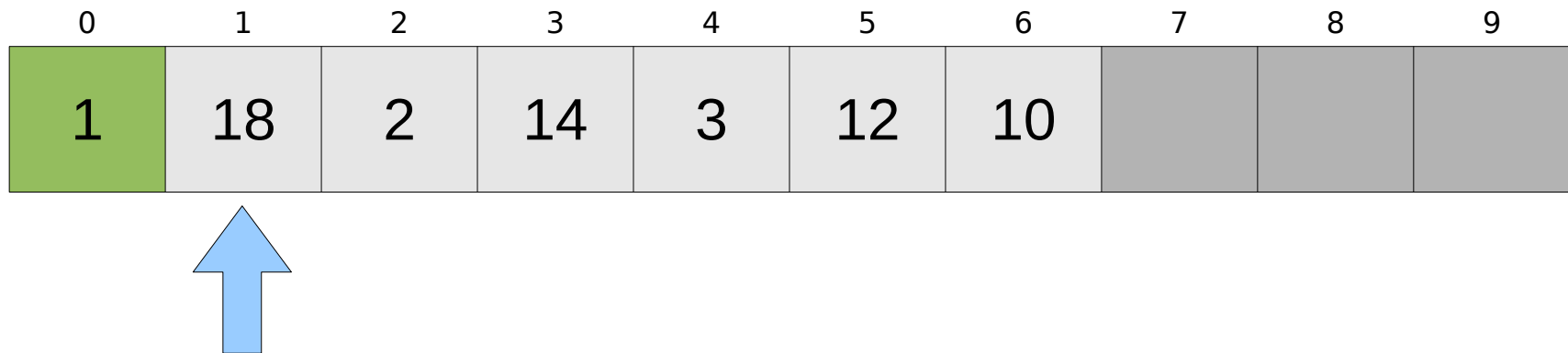
(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	18	2	14	3	12	10			

Now repeat the process for the remaining **unsorted portion** of the vector.

Selection Sort

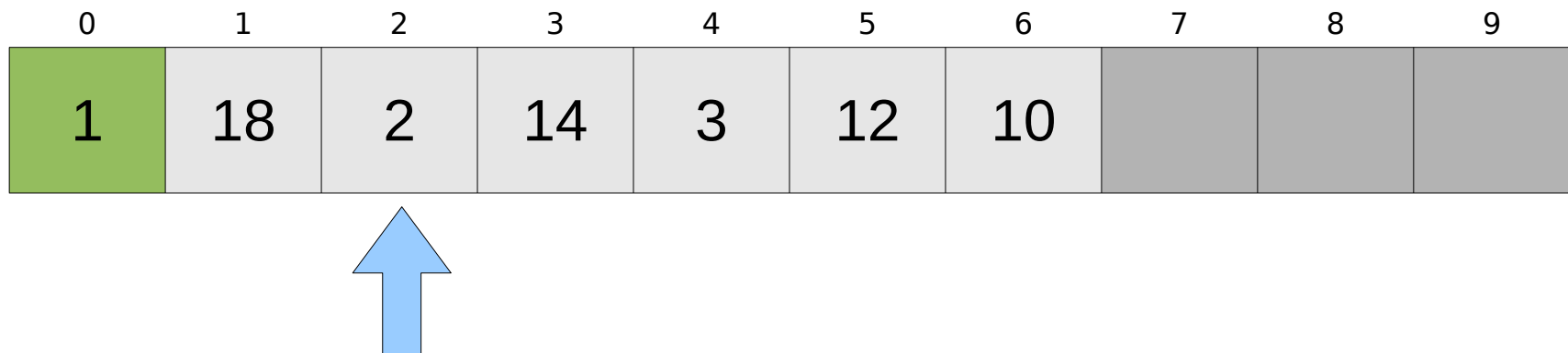
(select the smallest element)



Smallest element seen (so far): 18 (at index 1)

Selection Sort

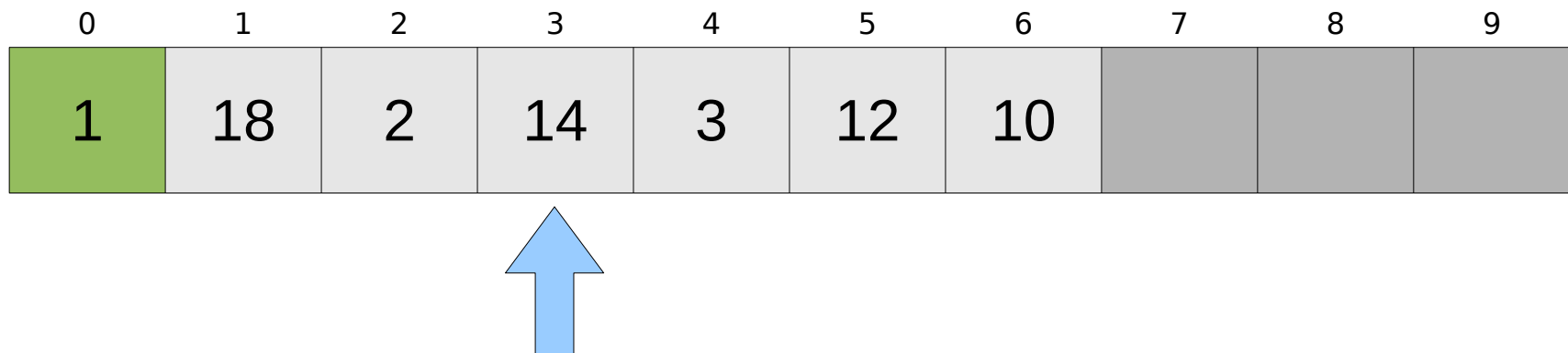
(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

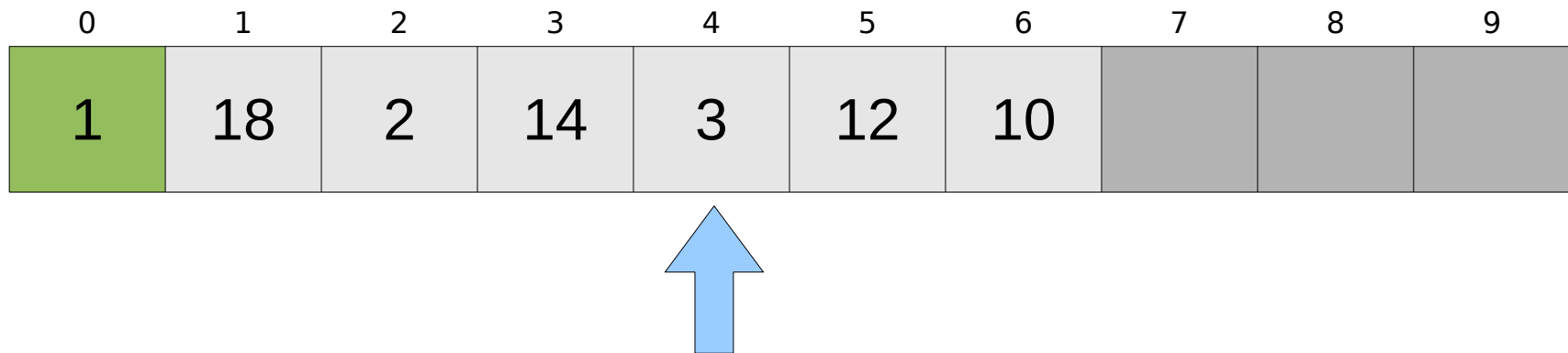
(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

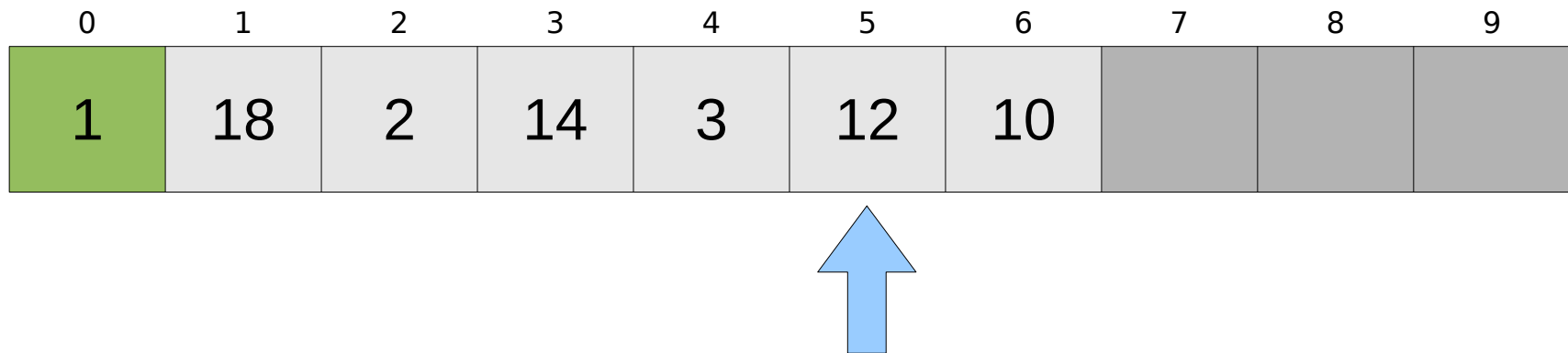
(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

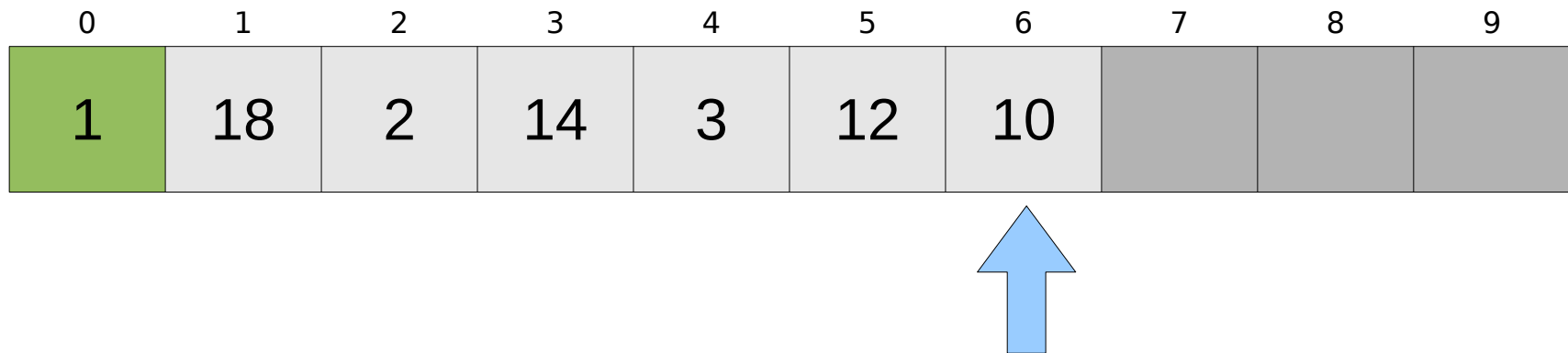
(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

(select the smallest element)



Smallest element seen (so far): 2 (at index 2)

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	18	2	14	3	12	10			

We have the **smallest element** from the **unsorted** part of the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	18	2	14	3	12	10			

We have the **smallest element** from the **unsorted** part of the vector.

Swap it into the **leftmost position** of the **unsorted portion** of the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	18	14	3	12	10			

We have the **smallest element** from the **unsorted** part of the vector.

Swap it into the **leftmost position** of the **unsorted portion** of the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	18	14	3	12	10			

We have the **smallest element** from the **unsorted** part of the vector.

Swap it into the **leftmost position** of the **unsorted portion** of the vector.

Mark that position as part of a **sorted portion** of the vector.

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	18	14	3	12	10			

We have the **smallest element** from the **unsorted** part of the vector.

Swap it into the **leftmost position** of the **unsorted portion** of the vector.

Mark that position as part of a **sorted portion** of the vector.

Selection Sort

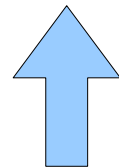
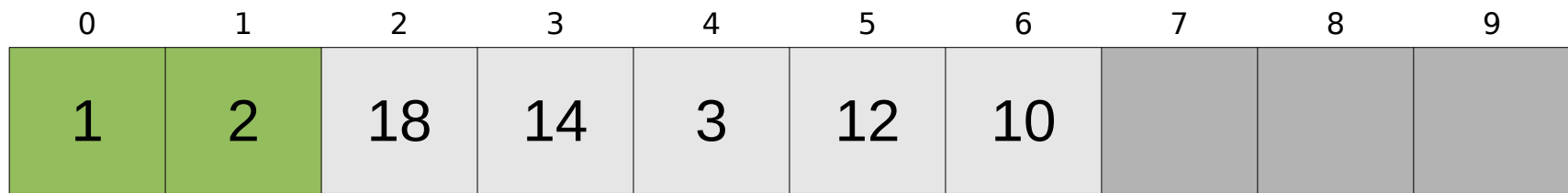
(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	18	14	3	12	10			

See if you can follow along...

Selection Sort

(select the smallest element)

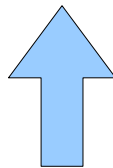
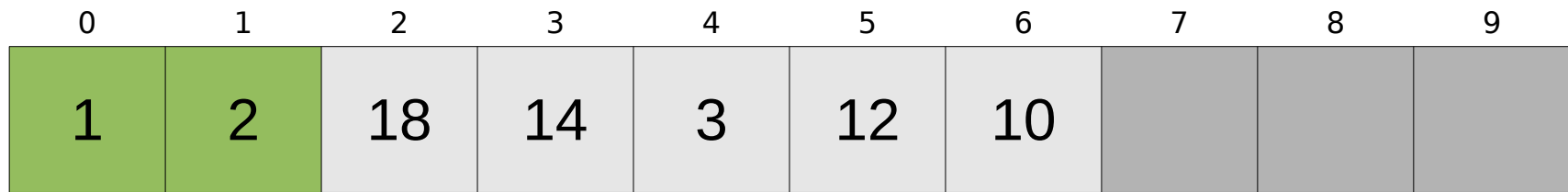


MIN: 18

See if you can follow along...

Selection Sort

(select the smallest element)



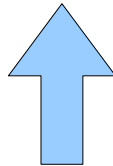
MIN: 14

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	18	14	3	12	10			

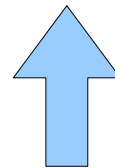
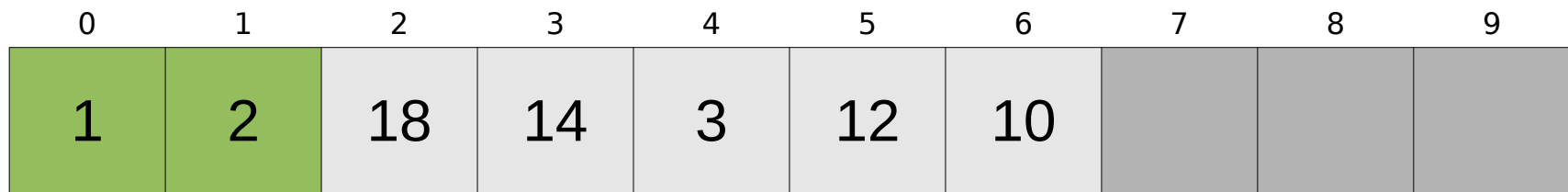


MIN: 3

See if you can follow along...

Selection Sort

(select the smallest element)

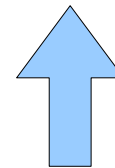
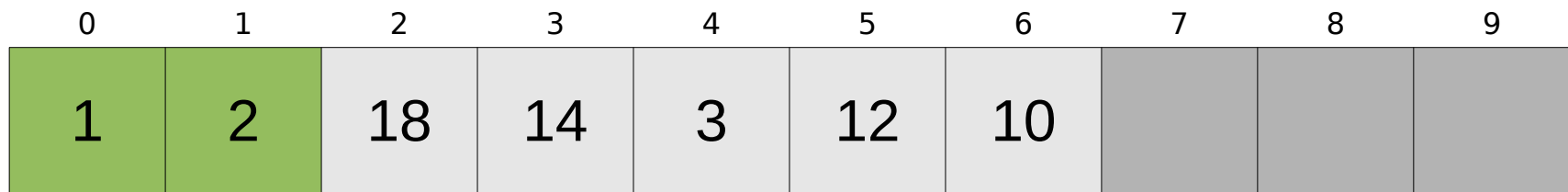


MIN: 3

See if you can follow along...

Selection Sort

(select the smallest element)



MIN: 3

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	18	14	3	12	10			

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	14	18	12	10			

See if you can follow along...

Selection Sort

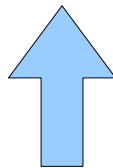
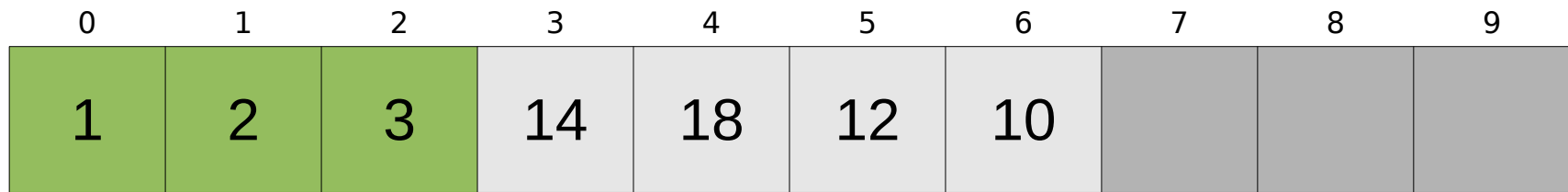
(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	14	18	12	10			

See if you can follow along...

Selection Sort

(select the smallest element)

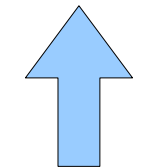
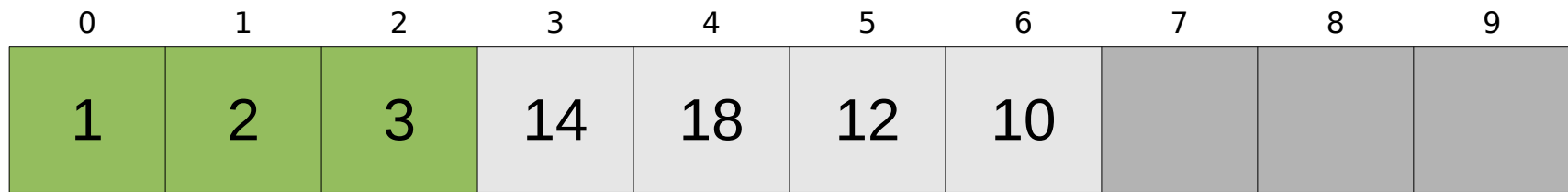


MIN: 14

See if you can follow along...

Selection Sort

(select the smallest element)

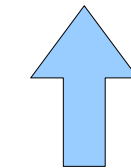
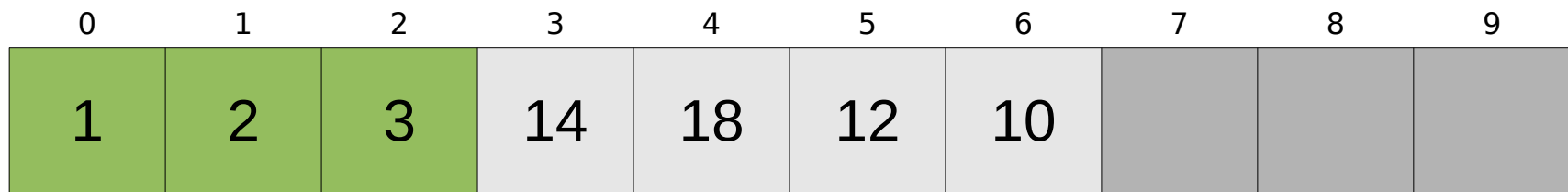


MIN: 14

See if you can follow along...

Selection Sort

(select the smallest element)

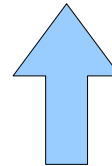
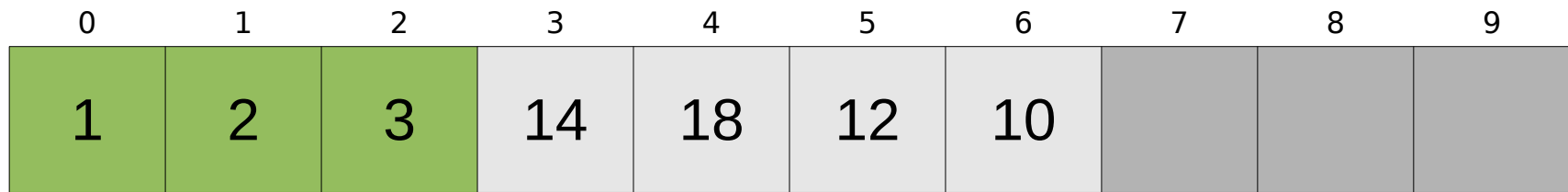


MIN: 12

See if you can follow along...

Selection Sort

(select the smallest element)



MIN: 10

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	14	18	12	10			

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	18	12	14			

See if you can follow along...

Selection Sort

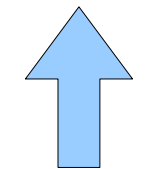
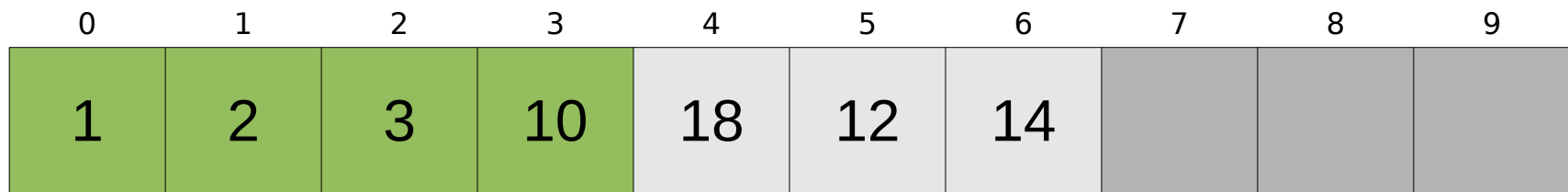
(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	18	12	14			

See if you can follow along...

Selection Sort

(select the smallest element)

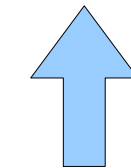
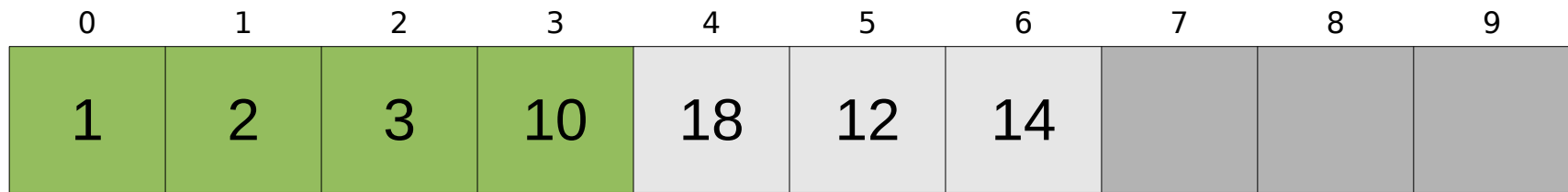


MIN: 18

See if you can follow along...

Selection Sort

(select the smallest element)

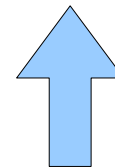
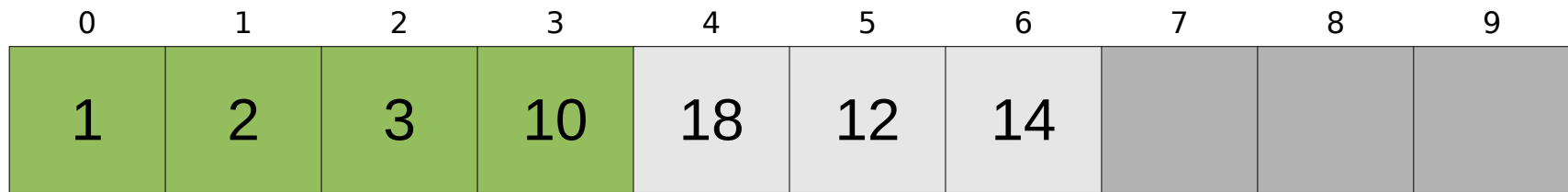


MIN: 12

See if you can follow along...

Selection Sort

(select the smallest element)



MIN: 12

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	18	12	14			

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	18	14			

See if you can follow along...

Selection Sort

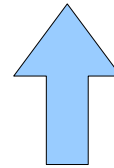
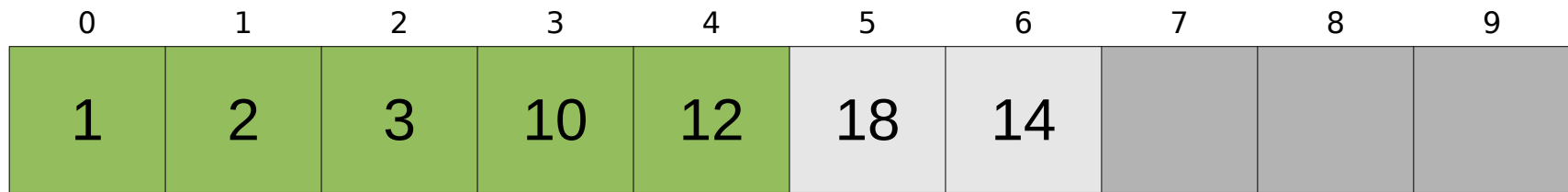
(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	18	14			

See if you can follow along...

Selection Sort

(select the smallest element)

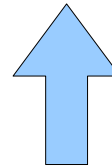
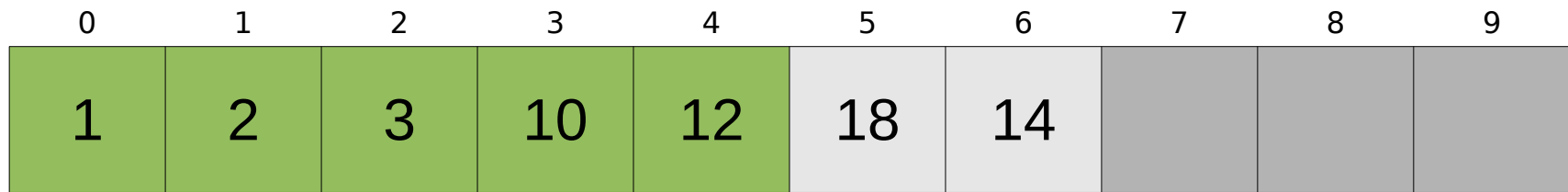


MIN: 18

See if you can follow along...

Selection Sort

(select the smallest element)



MIN: 14

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	18	14			

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	14	18			

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	14	18			

See if you can follow along...

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	14	18			

When there's **one element** left to be sorted,
we're **FINISHED!**

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	14	18			

When there's **one element** left to be sorted,
we're **FINISHED!**

Selection Sort

(select the smallest element)

0	1	2	3	4	5	6	7	8	9
1	2	3	10	12	14	18			

1. What's the **worst-case** Big-Oh runtime?
2. What's the **best-case** Big-Oh runtime?
3. Show the vector after **each pass** of Selection Sort.

Selection Sort

(let's code it up)

10	18	2	14	3	12	1			
----	----	---	----	---	----	---	--	--	--

```
void selectionSort(Vector<int>& v)
{
    for (int i = 0; i < v.size() - 1; i++)
    {
        int minIndex = i;

        for (int j = i + 1; j < v.size(); j++)
        {
            if (v[j] < v[minIndex])
            {
                minIndex = j;
            }
        }

        swap(v, i, minIndex);
    }
}
```