Static and Dynamic Arrays

Part 1/2

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Outline

- Discussion and examples about Arrays
    - What is an Array?
    - When and where is a Array used?
    - Complexity
    - Static array usage example
- Dynamic Array implementation details
- Code Implementation

Discussion and examples

What is a static Array?

A static array is a fixed length container containing n elements **indexable** from the range [0, n-1].

Q: What is meant by being ‘indexable’?

A: This means that each slot/index in the array can be referenced with a number.

When and where is a static Array used?

1) Storing and accessing sequential data

2) Temporarily storing objects

3) Used by IO routines as buffers

4) Lookup tables and inverse lookup tables

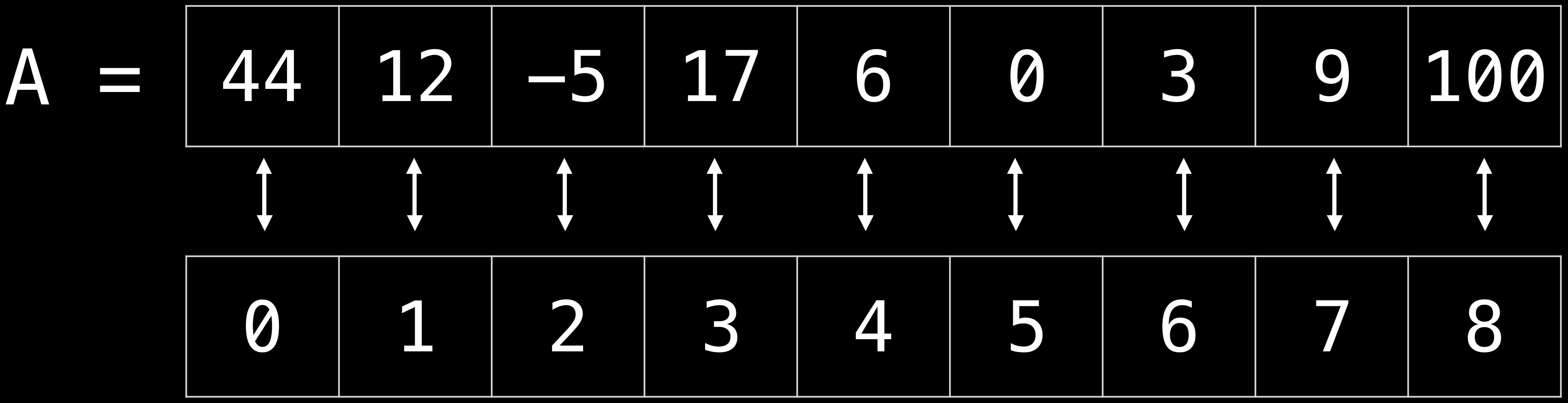
5) Can be used to return multiple values from a function

6) Used in dynamic programming to cache answers to subproblems

Complexity

	Static Array	Dynamic Array
Access	O(1)	O(1)
Search	O(n)	O(n)
Insertion	N/A	O(n)
Appending	N/A	O(1)
Deletion	N/A	O(n)

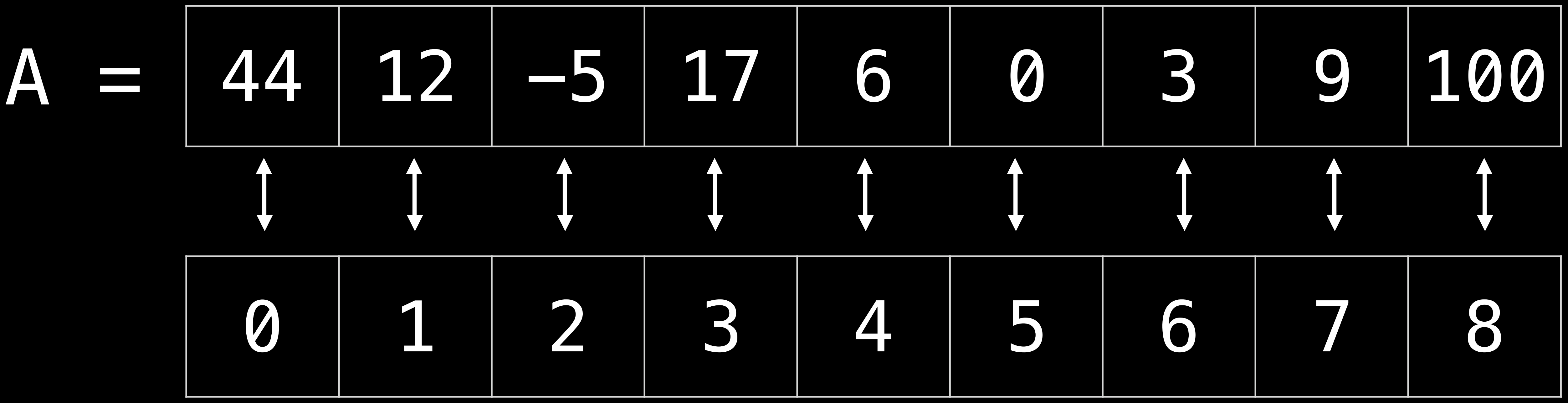
Static Array



A =	44	12	−5	17	6	0	3	9	100
	0	1	2	3	4	5	6	7	8

Elements in *A* are referenced by their index. There is no other way to access elements in an array. Array indexing is zero-based, meaning the first element is found in position zero.

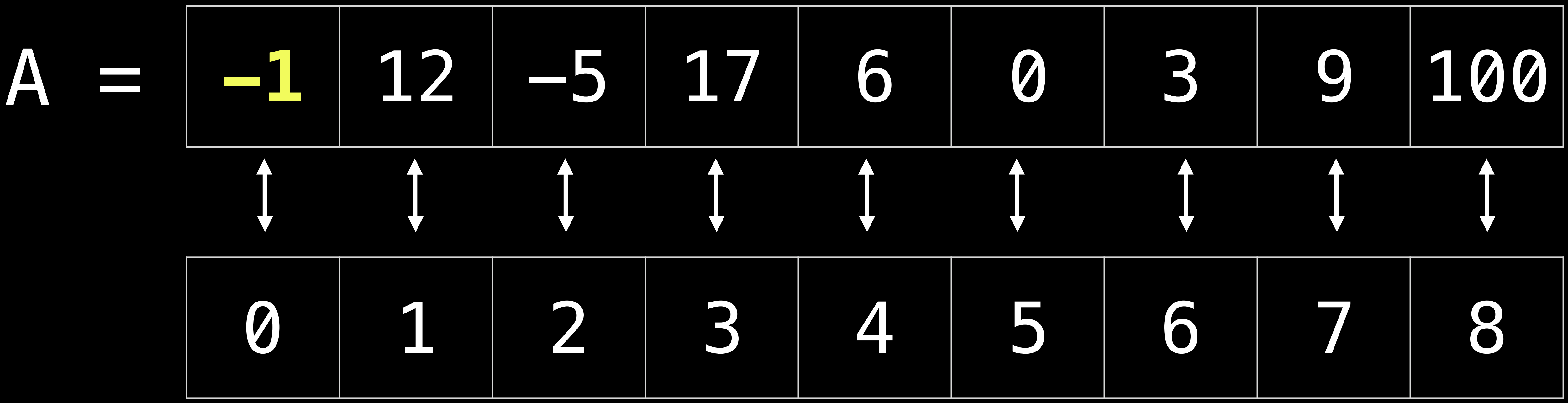
Static Array



A =	44	12	-5	17	6	0	3	9	100
	↕	↕	↕	↕	↕	↕	↕	↕	↕
	0	1	2	3	4	5	6	7	8

```
A[0] = 44
A[1] = 12
A[4] = 6
A[7] = 9
A[9] => index out of bounds!
```

Static Array

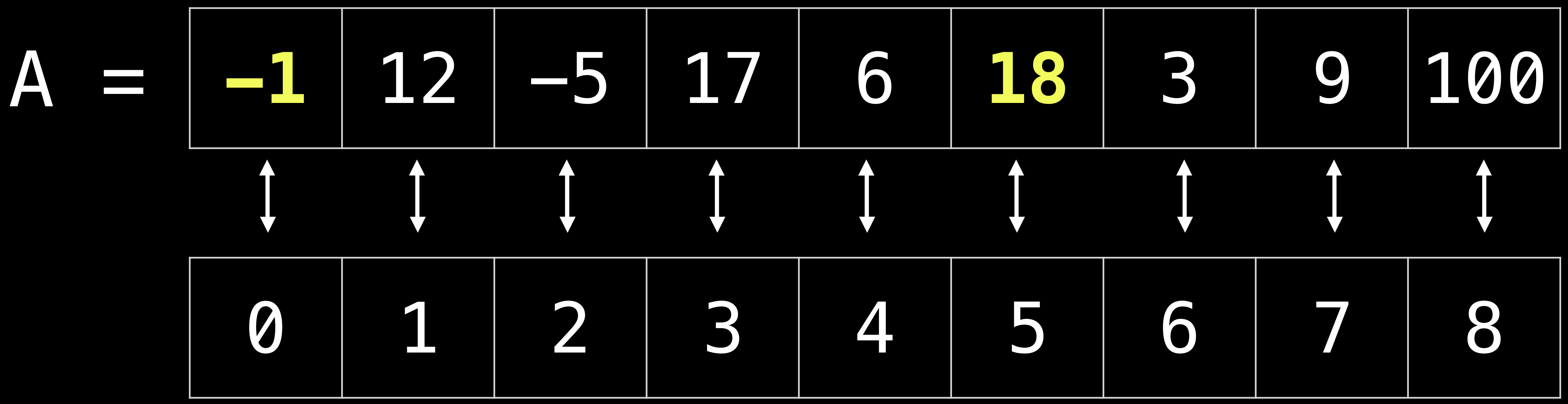


A =	-1	12	-5	17	6	0	3	9	100
	0	1	2	3	4	5	6	7	8

```
A[0] = 44
A[1] = 12
A[4] = 6
A[7] = 9
A[9] => index out of bounds!
```

```
A[0] := -1
```

Static Array



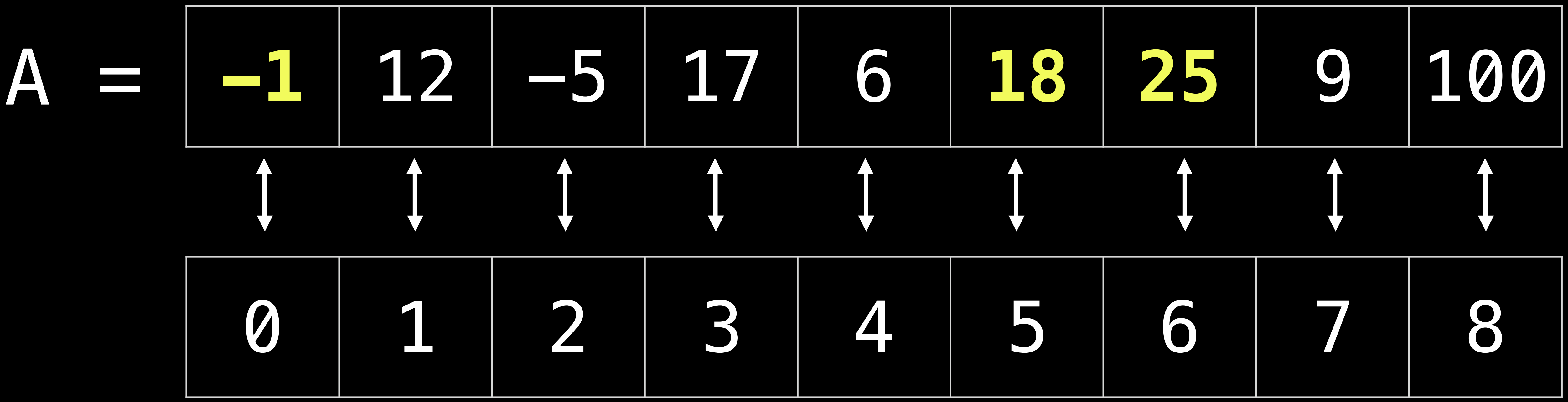
A =	-1	12	-5	17	6	18	3	9	100
	0	1	2	3	4	5	6	7	8

```
A[0] = 44
A[1] = 12
A[4] = 6
A[7] = 9
A[9] => index out of bounds!
```

```
A[0] := -1

A[5] := 18
```

Static Array



A =	**-1**	12	-5	17	6	**18**	**25**	9	100
	0	1	2	3	4	5	6	7	8

A[0] = 44

A[1] = 12

A[4] = 6

A[7] = 9

A[0] := -1

A[5] := 18

A[6] := 25

A[9] => index out of bounds!

Operations on Dynamic Arrays

Dynamic Array

The dynamic array can **grow** and **shrink** in size.

	A =	34	4		
A.add(-7)	A =	34	4	-7	
A.add(34)	A =	34	4	-7	34
A.remove(4)	A =	34	-7	34	

Dynamic Array

Q: How can we implement a dynamic array?

A: One way is to use a static array!

1) Create a static array with an initial capacity.

2) Add elements to the underlying static array, keeping track of the number of elements.

3) If adding another element will exceed the capacity, then create a new static array with twice the capacity and copy the original elements into it.

Dynamic Array

Suppose we create a dynamic array with an initial capacity of two and then begin adding elements to it.

Ø	Ø

7	Ø

7	**-9**

7	-9	**3**	Ø

7	-9	3	**12**

7	-9	3	12	**5**	Ø	Ø	Ø

7	-9	3	12	5	**-6**	Ø	Ø

Implementation of a dynamic array in next video

Implementation source code and tests can all be found at the following link:

github.com/williamfiset/data-structures

Dynamic Array Source Code

Part 2/2

William Fiset

Source Code Link

Implementation source code
and tests can all be found
at the following link:

github.com/williamfiset/data-structures

NOTE: Make sure you have understood part 1
from the Array series before continuing!