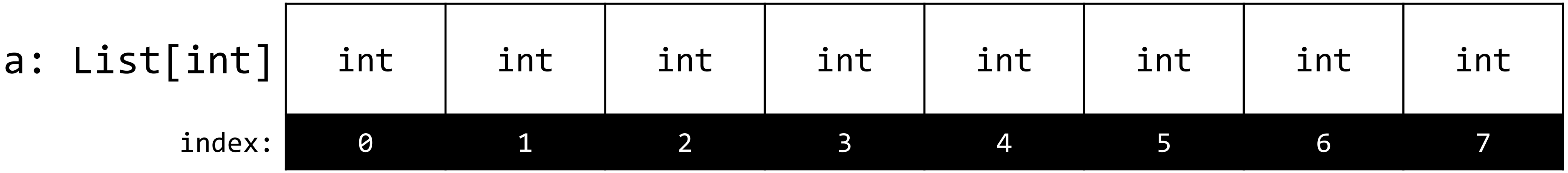
Lists!

Lists are a sequence of values of the same type...
...and can change at runtime!



a: List[int]	int	int	int	int	int	int	int	int
index:	0	1	2	3	4	5	6	7

1. Each item in a List* is called an ***item*** or an ***element***

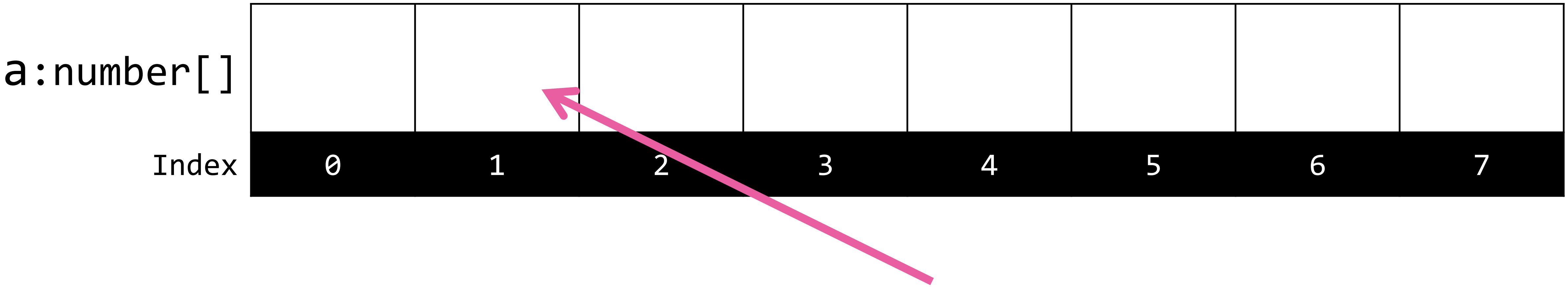
2. An element is a single value **addressed by its index** ("Room #")

3. All elements in a List are of the **same *type*****
   - An array of `ints, floats, strings, bools, and so on.`

* *Other languages may use the term array instead of list and may have subtly different characteristics.*

** *Technically*, in Python, you can create lists where elements are of many different types. While this flexibility sounds nice, the unpredictability of it is difficult to reason about in practice and is a common source of accidental errors. It is generally advised for lists to work with a *single type of data*.

Elements are addressed by the array variable's name and index



1. Notation: **`array_name[index]`**, i.e. **`a[1]`**

2. **Indexing starts at [0]** (not [1])
   - First index *always* 0
   - Last index *always* length of array – 1
   - This is a convention shared by most programming languages

Declaring and Initializing Lists

1. Import the type definition for List from the standard `typing` library*

   ```
   from typing import List
   ```

2. You can **declare a List** of *any type* by

   `<identifier>: List[type];` – list of <type>
   `ages: List[int]` – list of int values
   `words: List[str]` – list of str values

3. You **construct** an empty list in two ways:
   1. Use the List constructor with no argument: `list()`
   2. Use List literal with no elements: `[ ]`

4. These two initialization tasks are often done at the same time:

   ```
   words: List[str] = []
   ```

List Literals

- Initializing a List with a sequence of elements is frequently useful

- Using List Literal syntax, you can do this directly:

```
ages: List[int] = [18, 21, 20, 18, 19, 19]
words: List[str] = ["the", "quick", "brown", "fox", "jumped"]
```

- The List Literal syntax is a sequence of expressions, separated by commas, whose types match the List's type.

- There are other ways to initialize non-empty Lists you'll soon learn!
    1. Iterator-based initialization
    2. List comprehensions

Appending Elements to a List

- Lists are a *mutable* data structure that can grow (or shrink) in length!
  - Unlike Tuples and Strings!

- The **append** method adds an element to the end of a List
  - The element to add is the method's only parameter
  - The method returns None, because it *mutates* the List

- Examples:

```
ages.append(22)
words.append("over")
```

Removing Elements from a List

- The **pop** method removes an element at a given index from a List
  - The **index** to remove is the method's only parameter
  - The method returns the value previously stored at that index

- If no index is provided, the pop method defaults to the last index

- If the popped index is in the middle of the list, the indices of all following elements move back by one to avoid a "gap" in the middle of a list.

- Example:

```
ages: List[int] = [18, 19, 20, 21]

print(ages.pop(1))   # 19
print(ages)          # [18, 20, 21]
print(ages.pop())    # 21
print(ages)          # [18, 20]
```

Fundamental List Operations

Operation	Form	Example
Declaration	`name: List[type]`	`scores: List[int]`
Construction (Empty)	`name = []`	`scores = []`
Construction (Non-empty)	`name = [<comma separated values>]`	`scores = [12, 0, 9]`
# of Elements	`len(name)`	`len(scores)`
Access Element	`name[index]`	`scores[0]`
Assign Element	`name[index] = expression`	`scores[1] = 12`
Append Element Returns None.	`name.append(expression)`	`scores.append(13)`
Remove Element Returns removed element.	`name.pop(index_expression)`	`scores.pop(1)`