

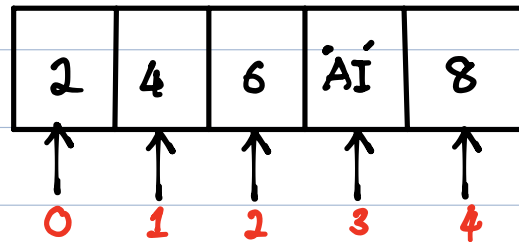
# List

A list is a container that stores objects.

These objects can be from same data types or different data types.

For Example 'AI'

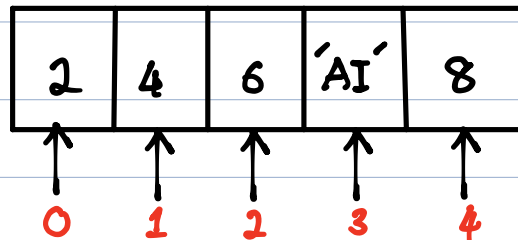
list = [2, 4, 6, 'AI', 8]



lists uses arrays as their internal structure.

That means items are stored in consecutive manner. by items, we mean the references to those items, not the actual items; items might be at different locations, but their addresses are stored one next to each other in a list.

list = [2, 4, 6, 'AI', 8]



In fact at 0<sup>th</sup> index, the element stored is not 2, but reference or the address of 2 in memory.

## Advantages

- ① Accessing to an element can be done fast.
- ② because of their sequential structure, they are memory friendly.

## Disadvantages

- ① insertion and deletion is slow.
- ② searching also takes more time, especially if lists are not sorted.

## How Does Lists works in Python?

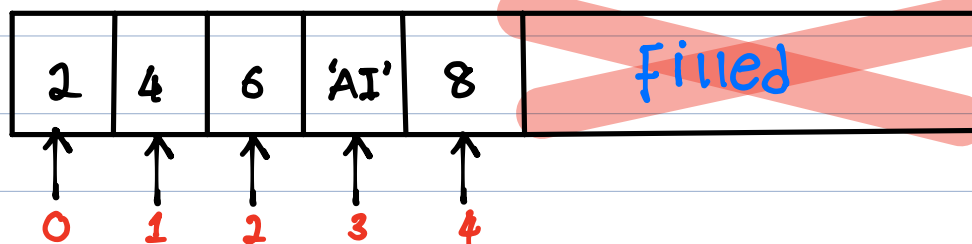
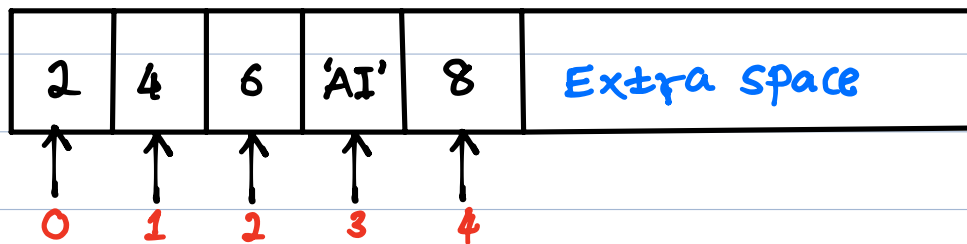
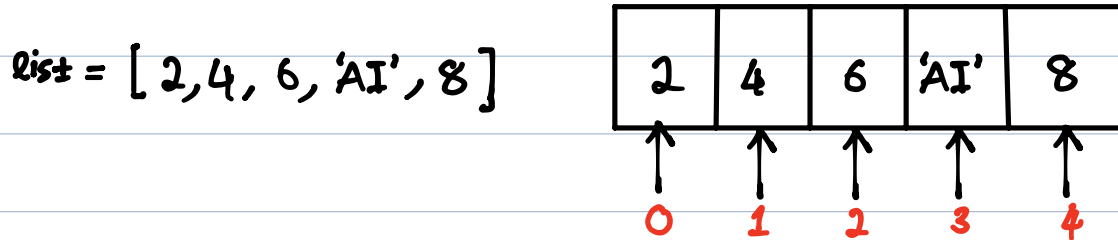
whenever a list is created, some extra spaces also will be allocated.

**why?** in case of adding more element, an entire space in memory should not be created.

in some other language like java, the size of an array will be which means after the array

is filled, if there is need of adding more element an entire new array should be created.

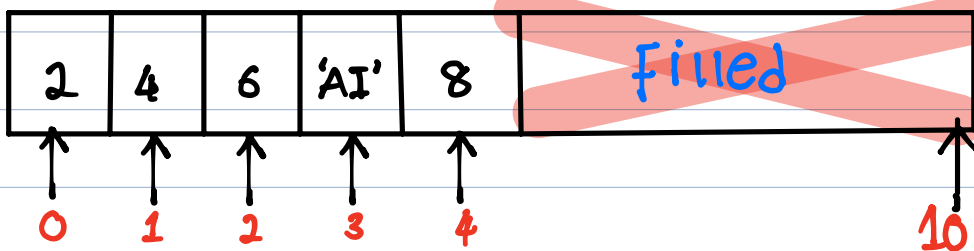
In Python upto certain size we are having freedom to add more elements, even if it gets filled, automatically more space will be added to the list. This the reason, lists are called dynamic arrays.



if extra space is also filled, The following steps will be followed

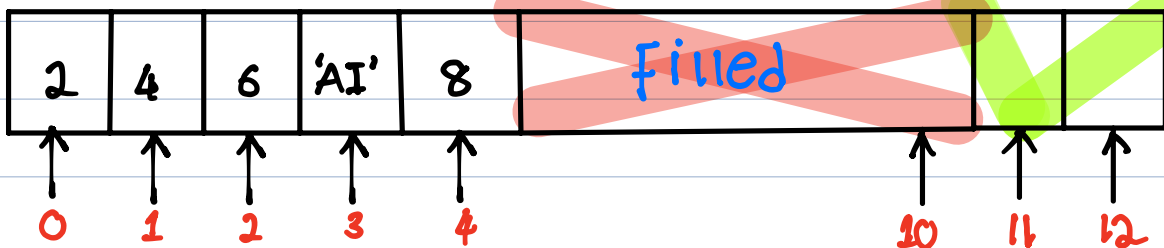
- ① Allocate new space of larger size (multiply by  $n$ )
- ② copy old list to the newly created list.
- ③ delete old list.

for python the size of newly created array will be **1.125** times larger than old array.



Lets say the maximum size of above list is 10, once it is filled, the size will be multiplied by 1.125  $(10)(1.125) = 11.25$ , we tends have more space, so the value will be 12.

Now a new array with size of 12 is created.



Time complexity to add elements and increase the size of a list

$$\text{Average time} = \frac{\text{total insertion time}}{\text{total \# elements to be inserted}}$$

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

$$= \frac{\theta(n) + \theta(n)}{\theta(n)} = \frac{2\cancel{\theta(n)}}{\cancel{\theta(n)}} = \theta(1)$$