

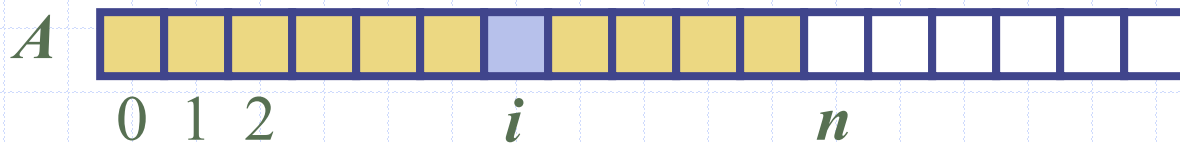
# Array-Based Sequences

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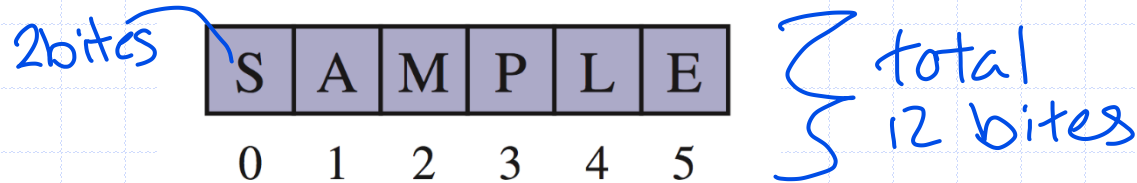
# Python Sequence Classes

- Python has built-in types, **list**, **tuple**, and **str**.
- Each of these **sequence** types supports indexing to access an individual element of a sequence, using a syntax such as  $A[i]$
- Each of these types uses an **array** to represent the sequence.
  - An array is a set of memory locations that can be addressed using consecutive indices, which, in Python, start with index 0.

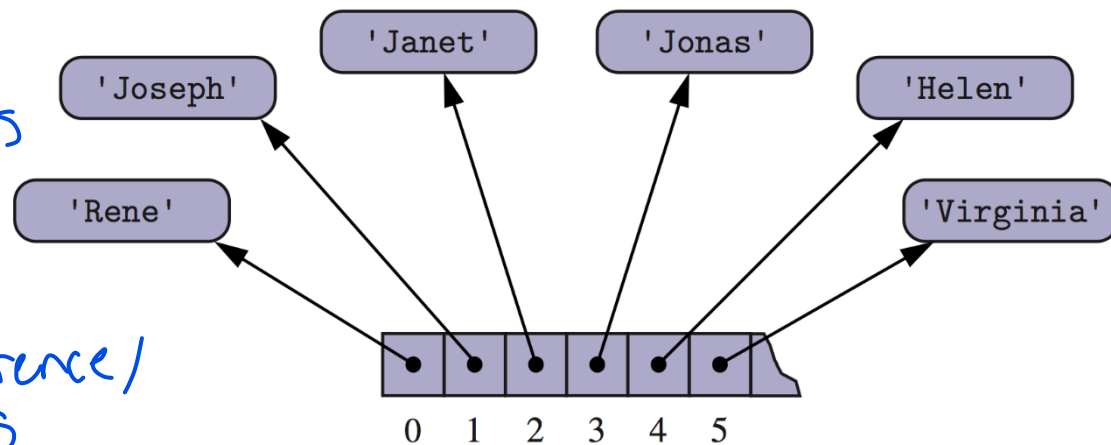


# Arrays of Characters or Object References

- An array can store primitive elements, such as characters, giving us a **compact array**.



- An array can also store references to objects.



↳ list items  
can be dif. sizes

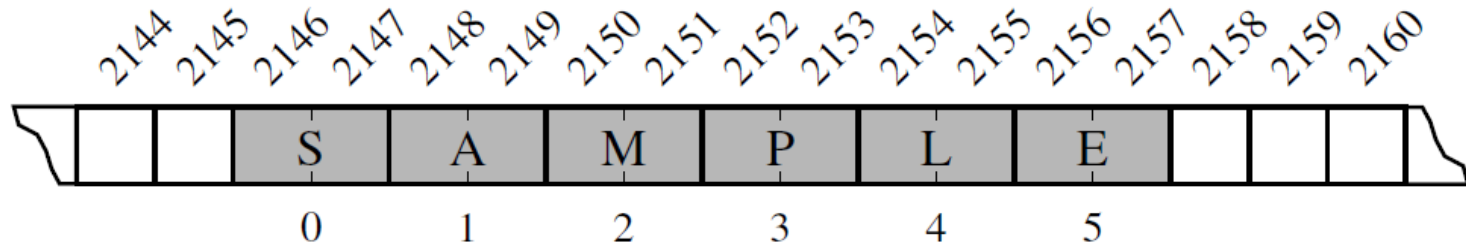
↳ can be  
dif. types

↳ storing reference/  
address

# Low-level Computer Architecture

RAM → Random Access  
↳ easier to access any index  
↳  $O(1)$  → 1 operation per cell

- Characters are represented using the Unicode character set
  - Python internally represents each Unicode character with 16 bits



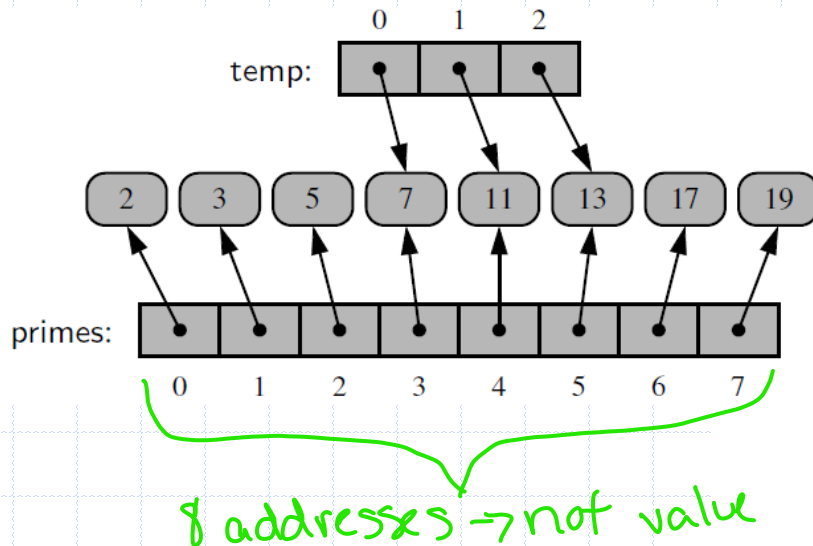
- Computer's main memory performs as *random access memory (RAM)*.
  - It is just as easy to retrieve byte #8675309 as it is to retrieve byte #309. →  **$O(1)$  complexity**

Primes = (2, 3, 5, 7, 11, ...)

# Referential Arrays I

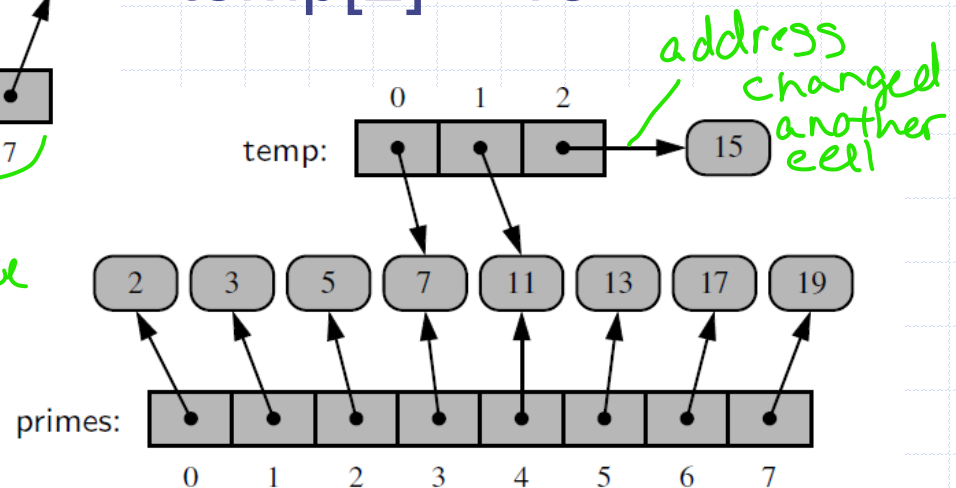
temp = primes[3:6]  
↳ slice  
↳ pointer not copy

temp = primes[3:6]

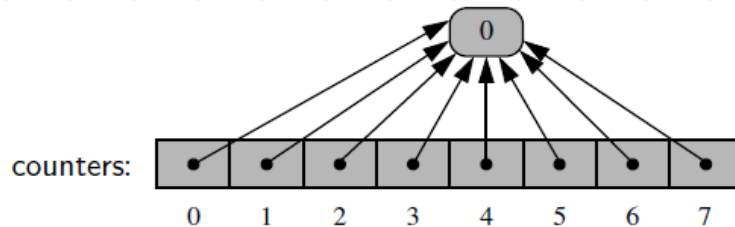


addresses: 2 value

temp[2] = 15



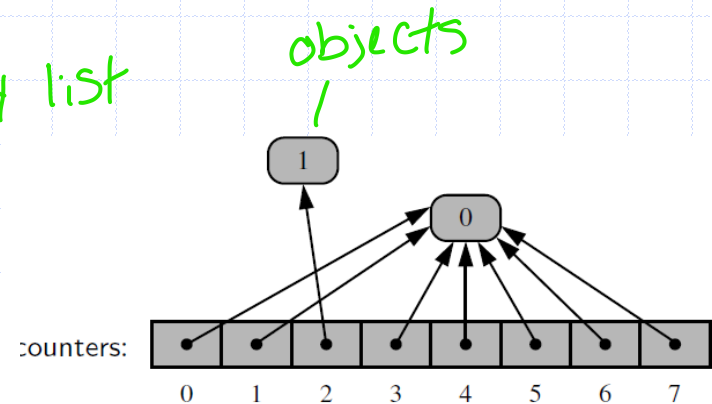
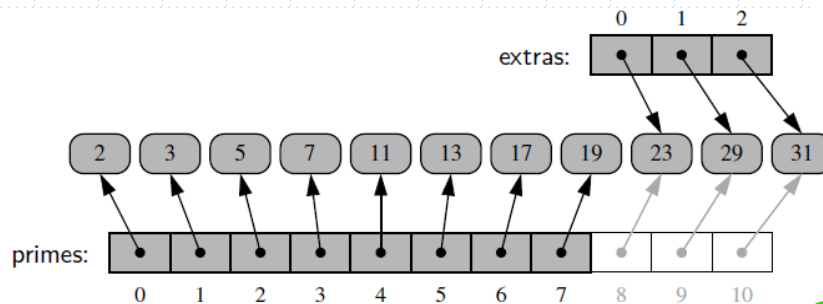
# Referential Arrays II



64-bits: size of memory  
address stored in the array

$\text{data} = [0] * 8 \rightarrow \text{empty list}$

$\text{extras} = [23, 29, 31]$



$\text{data}[2] += 1$

$\text{primes.extend(extras)}$

$\rightarrow$  mutable / immutable  
 $\hookrightarrow$  primes can access pointers in extras

# Compact Arrays

fixed size  
& same type

python gets  
around this by  
creating objects  
in other locations  
& pointing to  
them

- Primary support for compact arrays is in a module named **array**.
  - That module defines a class, also named array, providing compact storage for arrays of primitive data types.
- The constructor for the array class requires a type code as a first parameter, which is a character that designates the type of data that will be stored in the array.

```
primes = array('i', [2, 3, 5, 7, 11, 13, 17, 19])
```

int → type

can put in  
values

# Type Codes in the array Class

- Python's array class has the following type codes:

Code	C Data Type	Typical Number of Bytes
'b'	signed char	1
'B'	unsigned char	1
'u'	Unicode char	2 or 4
'h'	signed short int	2
'H'	unsigned short int	2
'i'	signed int	2 or 4
'I'	unsigned int	2 or 4
'l'	signed long int	4
'L'	unsigned long int	4
'f'	float	4
'd'	float	8