# Index, Range and Slice Operations:

L = [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120]

|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

__Index operator__: Applied on list object and index returns whichever type of the object is at the index.

e.g. L[3] == 40    L[7] == 80   etc.

Range Operator?

Syntax: L[i : j]

Intention: Range operation returns the sublist as a new list object.

|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

L1 = __L[3 : 7]__
        Range Syntax.

L [ i : j ]
     /       \
    3        7

L[i:j] allocates a new list and adds elements from index $i$ to $j-1$ into a newly allocated list.
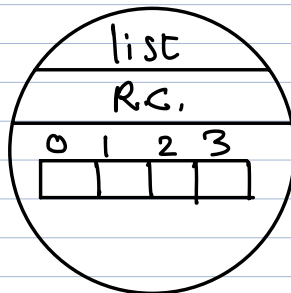
# Diagramatic Evaluation:

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$L1 = L[3:7]$$

$$i = 3, \quad j = 7 \quad j-1 = 6$$

## Step-1: Allocate new list

```
    list
    R.C.
  0  1  2  3
 ┌──┬──┬──┬──┐
 │  │  │  │  │
 └──┴──┴──┴──┘
```

## Step-II: Add elements from index i to j-1
index 3 to 6
(in our case)

```
    list
    R.C.
  0  1  2  3
 ┌──┬──┬──┬──┐
 │  │  │  │  │
 └──┴──┴──┴──┘
  40  50  60  70
```
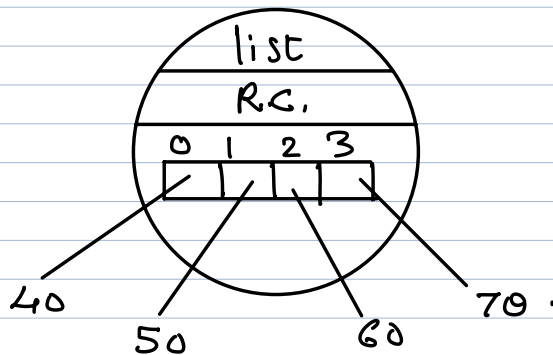
## Step-III: Attach variable L1 with it

L1 ●

```
    list
    R.C.
  0  1  2  3
 ┌──┬──┬──┬──┐
 │  │  │  │  │
 └──┴──┴──┴──┘
  40  50  60  70
```
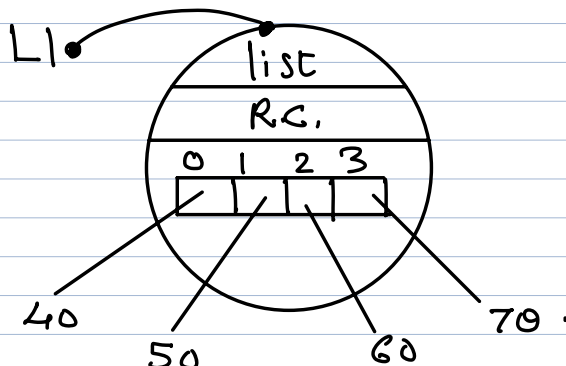
|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|----|----|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[1:6] \qquad i=1, j=6, j-1=5$$

$$M == [20,30,40,50,60]$$

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|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|----|----|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[0:4] \qquad i=0, j=4, j-1=3$$

$$M == [10,20,30,40].$$

|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|----|----|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[7:11] \qquad i=7, j=11, j-1=10$$

$$M = [80,90,100,110].$$

|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|----|----|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[7:12] \qquad i=7, j=12, j-1=11$$

$$M = L[7:len(L)] \qquad i=7, j=len(L)=12$$

$$j-1 = 11$$

$$L = [80,90,100,110,120]$$

---

|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|----|----|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[4:4] \qquad i=4, j=4, j-1=3$$

$$M == [\ ]$$
empty list.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[7:2] \qquad i=7, \ j=2 \qquad j-1=1$$

$$M == [\ ] \quad \leftarrow \text{empty list.}$$

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[4:5] \qquad i=4, \ j=5 \quad j-1=4$$

$$M = [50]$$
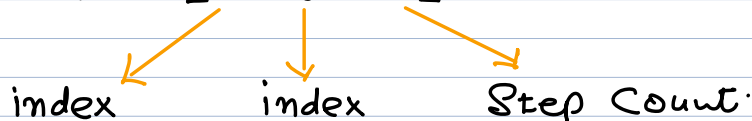
$$i < j \longrightarrow len(L[i:j]) > 0$$

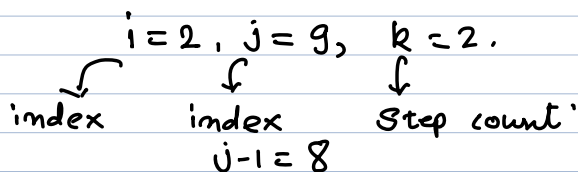$$i \geqslant j \longrightarrow len(L[i:j]) == 0.$$

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Slice:

General Syntax:

$$M = L[i:j:k]$$

index     index     Step Count.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[2:9:2] \qquad\qquad M = [30, 50, 70, 90]$$

$$i=2, \ j=9, \quad k=2.$$

index     index     Step count

$$j-1 = 8$$

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$M = L[2 : 9 : 3] \qquad M = [30, 60, 90]$$

$$i = 2, \quad j = 9, \quad k = 3$$
$$j - 1 = 8$$

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| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

Examples:

① $M = L[1 : 8 : 1]$      ⑤ $M = L[3 : 5 : 4]$

② $M = L[2 : 10 : 4]$      ⑥ $M = L[3 : 4 : 2]$

③ $M = L[0 : 11 : 2]$      ⑦ $M = L[3 : 4 : 1]$

④ $M = L[0 : 12 : 2]$      ⑧ $M = L[4 : 4 : 1]$

---

$$M = L[i : j : k] \qquad i + 0 \times k, \ i + 1 \times k$$

$$i < j \quad \text{and} \quad k > 0$$

Collect elements at the following indices

$$i, \ i + k, \ i + 2 \times k, \ i + 3 \times k, \ \dots, \ i + r \times k$$

   such that $(i + r \times k) < j$

   and $\qquad (i + (r+1) \times k) \geqslant j$

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| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |

$$L[3 : 10 : 2]$$

$$3, \ 3+2, \ 3+2\times2, \ \Big| \ 3+3\times2 . \ \| \ 3 + 4 \times 2$$

$$3 < 10 \quad 5 < 10 \qquad 7 < 10 \qquad\qquad 9 < 10 \qquad\qquad 11 \leq 10 \ ✗$$

$i : j : k$

$i \qquad i+k \qquad i+k+k \qquad i+k+k+k$

$\qquad\qquad\qquad\quad i+2 \times k \qquad i+3 \times k$

$i \quad i+k \quad i+2k \;-\;-\; i+rk$

$\qquad\qquad\qquad\qquad i+rk < j$

$\qquad\qquad\qquad\quad i+rk+k$

$\qquad\qquad\quad (i+(r+1)k) \geqslant j$