Chapter 6: Lists

SECTIONS 6.2 – 6.3

LIST OPERATIONS & COMMON LIST ALGORITHMS

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List Operations

- Appending Elements
- Inserting an Element
- Finding an Element
- Removing an Element
- Concatenation
- Equality / Inequality Testing
- Sum, Maximum, Minimum, and Sorting
- Copying Lists

Appending Elements

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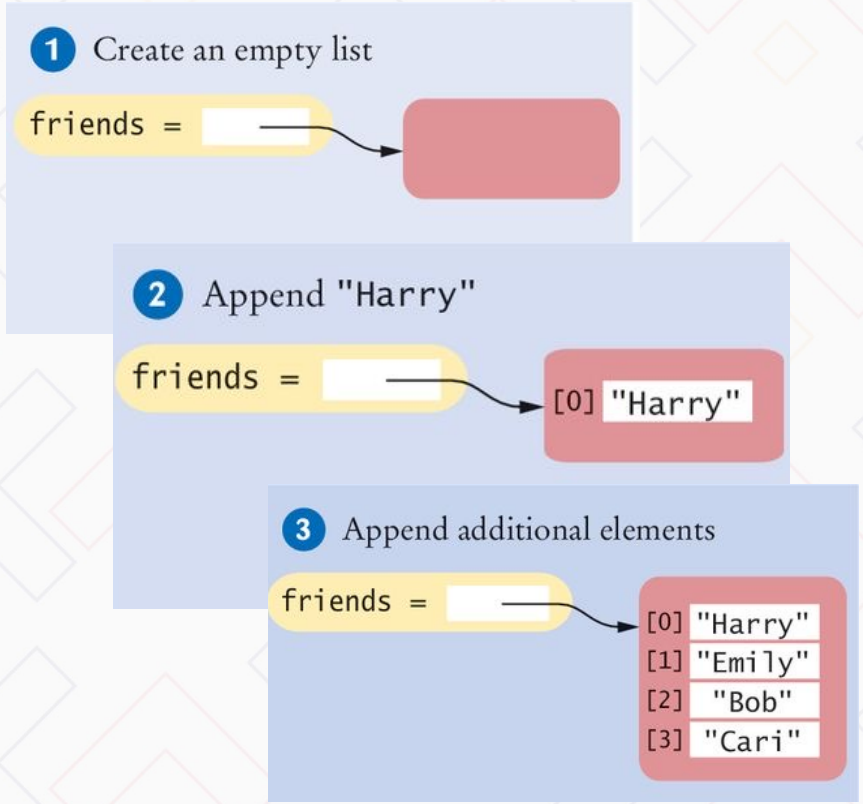
- Sometimes we may not know the values that will be contained in the list when it's created
- In this case, we can create an empty list and add elements to the end as needed
- Syntax:
  `listName.append(elementValue)`
  - `listName` is the name of the list where you are going to append a new element to the end of the list
  - `elementValue` is the value that is going to be added

Appending Elements - Example

```
#1
friends = []

#2
friends.append("Harry")

#3
friends.append("Emily")
friends.append("Bob")
friends.append("Cari")
```



Inserting an Element

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- Sometimes the order in which elements are added to a list is important
  - A new element has to be inserted at a specific position in the list
- Syntax:

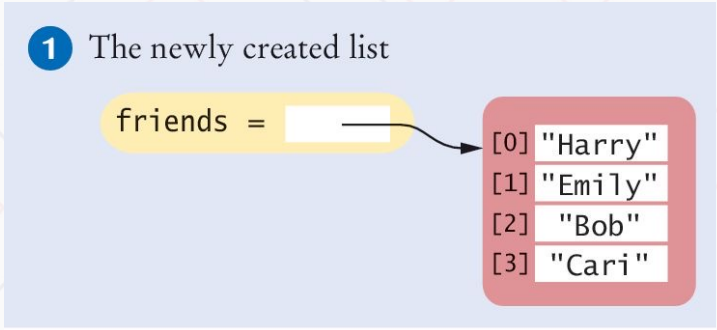
```
listName.insert(index, elementValue)
```

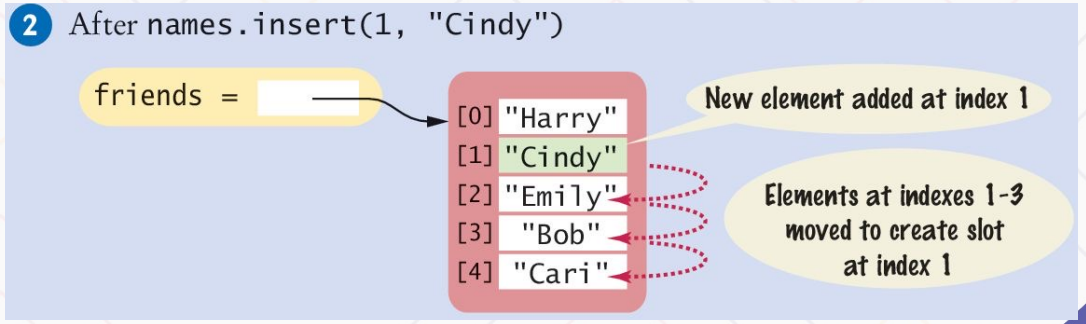
  - `listName` is the name of the list where you are going to insert a new element
  - `index` is the location where you are going to insert the item
  - `elementValue` is the value that is going to be inserted
  - All the elements located after `index` will be moved down one location to create a space for the new element.

Inserting an Element - Example

```
#1
friends = ["Harry",
"Emily", "Bob", "Cari"]

#2
friends.insert(1,
"Cindy")
```





Finding an Element (1)

- If you simply want to know whether an element is present in a list, use the in operator
- Syntax:
  `elementValue in listName`
  - `elementValue` is the element that needs to be checked if it exists or not
  - `listName` is the name of the list where you are going to search for the element
- Example:

```
if "Cindy" in friends :
    print("She's a friend")
```

Finding an Element (2)

- If you want to know the position at which an element occurs
  - The index() method yields the index of the first match
- Syntax:
  `listName.index(elementValue)`
  - `listName` is the name of the list where you are going to search for the element
  - `elementValue` is the value that you are looking for
- Example:

```
friends = ["Harry", "Emily", "Bob", "Cari", "Emily"]
n = friends.index("Emily") # Sets n to 1
```

Removing an Element

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- You can remove an element by its value or its location
  - The `pop()` method removes the element at a given position

    Syntax:

    ```
    listName.pop(index)
    ```

    - `listName` is the name of the list from which you are going to remove an element
    - `index` is the position of the element that is going to be removed
  - The `remove()` method removes an element by value

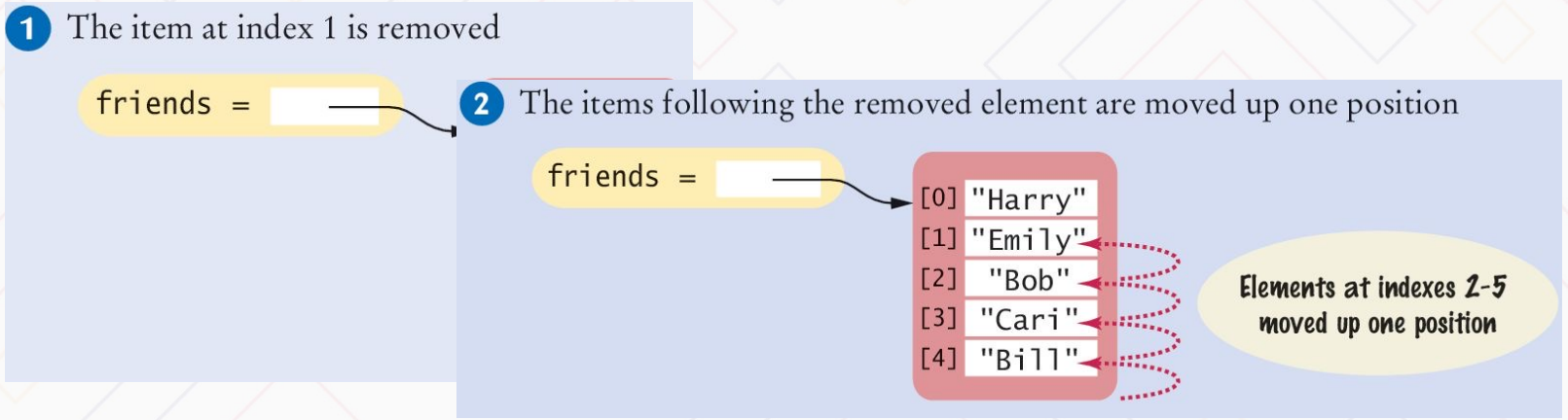
    Syntax:

    ```
    listName.remove(elementValue)
    ```

    - `listName` is the name of the list from which you are going to remove an element
    - `elementValue` is the element that is going to be removed
- All of the elements following the removed element are moved up one position to close the gap
- The length of the list is reduced by 1
- Calling `pop()` without an index removes the last element from the list

Removing an Element - Example

```
friends = ["Harry", "Cindy", "Emily", "Bob", "Cari","Bill"]
friends.pop(1)
```



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Concatenation

- The concatenation of two lists is a new list that contains the elements of the first list, followed by the elements of the second
- Two lists can be concatenated by using the plus (+) operator
- Syntax:

  `listName= list1 + list2`

  - `listName` is the name of the list that will contain the elements from `list1` followed by the elements from `list2`
  - `list1` contains the elements of the first list
  - `list2` contains the elements of the second list
- Example:

```
myFriends = ["Fritz", "Cindy"]
yourFriends = ["Lee", "Pat", "Phuong"]
ourFriends = myFriends + yourFriends
# Sets ourFriends to ["Fritz", "Cindy", "Lee", "Pat","Phuong"]
```

Replication

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- As with string, replication of a list is a concatenation of the same list multiple times
- Syntax:
  `newList = listName * numberOfReplications`
  - `newList` is the list that will contain the replication of `listName`
  - `listName` is the name of the list or the list elements that will be replicated
  - `numberOfReplications` specifies how many copies of `listName` should be concatenated
- Example:

```
monthInQuarter = [ 1, 2, 3] * 4
```

  - Results in the list [1, 2, 3, 1, 2, 3, 1, 2, 3, 1, 2 ,3]
- You can place the `numberOfReplications` on either side of the "*" operator
- One common use of replication is to initialize a list with a fixed value

```
monthlyScores = [0] * 12
```

Equality / Inequality Testing

- You can use the == operator to compare whether two lists have the same elements, in the same order.

```
[1, 4, 9] == [1, 4, 9]      # True
[1, 4, 9 ] == [4, 1, 9]     # False.
```

- The opposite of == is !=.

```
[1, 4, 9] != [4, 9]      # True.
```

Sum, Maximum, Minimum

- If you have a list of numbers, the sum() function yields the sum of all values in the list.

```
sum([1, 4, 9, 16]) # Yields 30
```

- For a list of numbers or strings, the max() and min() functions return the largest and smallest value:

```
max([1, 16, 9, 4])                    # Yields 16
min("Fred", "Ann", "Sue")             # Yields "Ann"
```

Sorting

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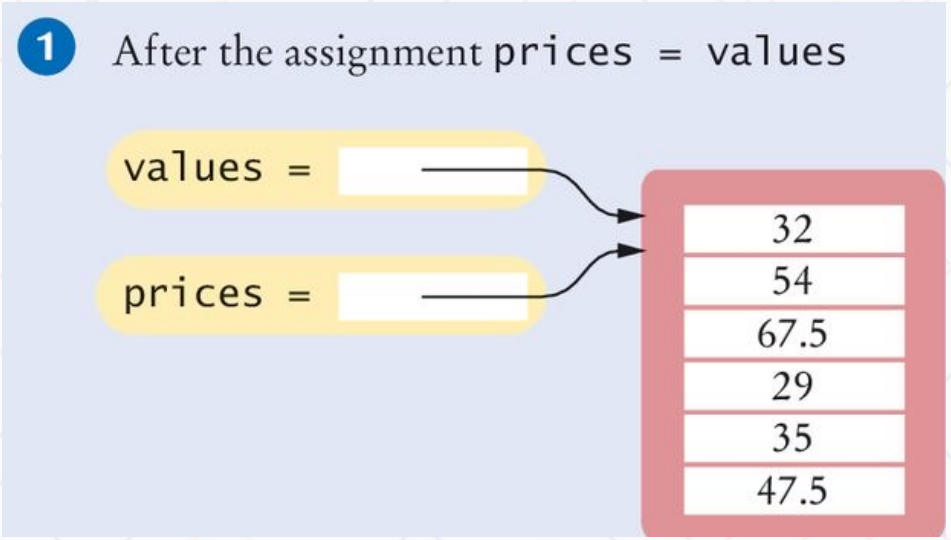
- The sort() method sorts a list of numbers or strings.

```
values = [1, 16, 9, 4]
values.sort() # Now values is [1, 4 , 9, 16]
```

Copying Lists

- As discussed, list variables do not themselves hold list elements
- They hold a reference to the actual list
- If you copy the reference, you get another reference to the same list:

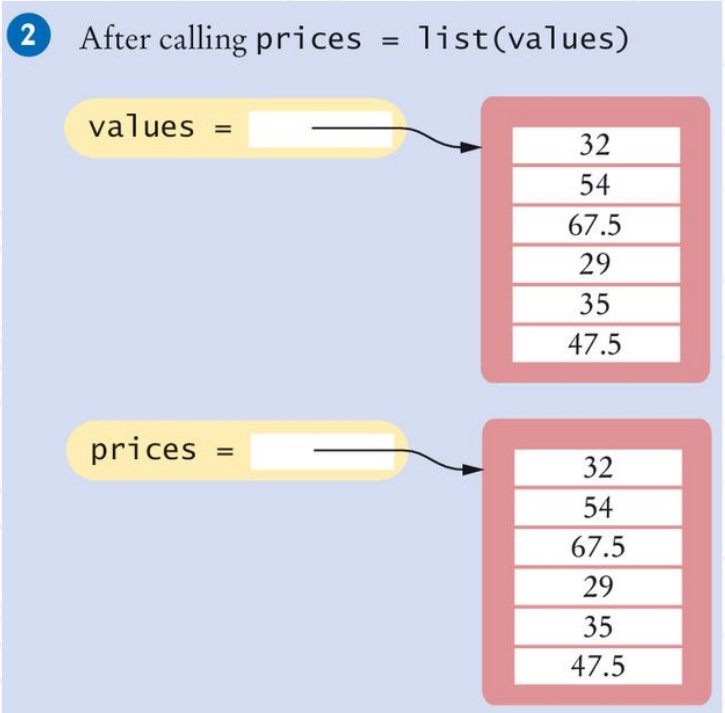
```
prices = values
```



Copying Lists (2)

- Sometimes, you want to make a copy of a list; that is, a new list that has the same elements in the same order as a given list
- Use the list() function:

```
prices = list(values)
```



Slices of a List

- Sometimes you want to look at a part of a list. Suppose you are given a list of temperatures, one per month:

```
temperatures = [18, 21, 24, 33, 39, 40, 39, 36, 30, 22, 18]
```

- You are only interested in the temperatures for the third quarter, with index values 6, 7, and 8
- You can use the slice operator to obtain them:

```
thirdQuarter = temperatures[6 : 9]
```

- The arguments are the first element to include, and the first to exclude
  - So in our example we get elements 6, 7, and 8

Slices (2)

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- Both indexes used with the slice operator are optional
- If the first index is omitted, all elements from the beginning are included until one element before the second index
- Examples:

```
temperatures[ : 6]
```

  - Includes all elements up to, but not including, position 6

```
temperatures[6 : ]
```

  - Includes all elements starting at position 6 to the end of the list

- You can assign values to a slice

```
temperatures[6 : 9] = [45, 44, 40]
```

  - Replaces the values in elements 6, 7, and 8

- The size of the slice and replacement do not have to match

  friends[: 2] = [“Peter”, “Paul”, “Mary”]

  - Replaces the first two elements of friends with three new elements, increasing the length of the list.

Common List Functions And Operators

Table 1 Common List Functions and Operators

Operation	Description
`[]` `[`$elem_1$, $elem_2$, ..., $elem_n$`]`	Creates a new empty list or a list that contains the initial elements provided.
`len(`*l*`)`	Returns the number of elements in list *l*.
`list(`*sequence*`)`	Creates a new list containing all elements of the sequence.
`values * num`	Creates a new list by replicating the elements in the `values` list `num` times.
`values + moreValues`	Creates a new list by concatenating elements in both lists.

Common List Functions And Operators (2)

Table 1 Common List Functions and Operators

Operation	Description
`l[from : to]`	Creates a sublist from a subsequence of elements in list *l* starting at position `from` and going through but not including the element at position `to`. Both `from` and `to` are optional. (See Special Topic 6.2.)
`sum(l)`	Computes the sum of the values in list *l*.
`min(l)` `max(l)`	Returns the minimum or maximum value in list *l*.
l_1 == l_2	Tests whether two lists have the same elements, in the same order.

Common List Methods

Table 2 Common List Methods

Method	Description
l.pop() *l*.pop(*position*)	Removes the last element from the list or from the given position. All elements following the given position are moved up one place.
l.insert(*position*, *element*)	Inserts the `element` at the given position in the list. All elements at and following the given position are moved down.
l.append(*element*)	Appends the element to the end of the list.
l.index(*element*)	Returns the position of the given element in the list. The element must be in the list.
l.remove(*element*)	Removes the given element from the list and moves all elements following it up one position.
l.sort()	Sorts the elements in the list from smallest to largest.

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Common List Algorithms

SECTION 6.3

Common List Algorithms

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- **Filling a List**
- **Combining List Elements**
- Element Separators
- Maximum and Minimum
- **Linear Search**
- Collecting and Counting Matches
- Removing Matches
- Swapping Elements
- **Reading Input**

Filling a List

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- This loop creates and fills a list with squares (0, 1, 4, 9, 16, ...)

```
values = []
for i in range(n) :
    values.append(i * i)
```

Combining List Elements

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- Here is how to compute a sum of numbers:

```
result = 0.0
for element in values :
    result = result + element
```

- To concatenate strings, you only need to change the initial value:

```
result = ""
for element in names :
    result = result + element
```

Linear Search

- Finding the first value that is > 100. You need to visit all elements until you have found a match or you have come to the end of the list:

```
limit = 100
pos = 0
found = False
while pos < len(values) and not found :
    if values[pos] > limit :
        found = True
    else :
        pos = pos + 1
if found :
    print("Found at position:", pos)
else :
    print("Not found")
```

A linear search inspects elements in sequence until a match is found.

Reading Input

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- It is very common to read input from a user and store it in a list for later processing.

```
values = []
print("Please enter values, Q to quit:")
userInput = input("")
while userInput.upper() != "Q" :
    values.append(float(userInput))
    userInput = input("")
```

```
Please enter values, Q to quit:
32
29
67.5
Q
```

Program execution