Example: Summing the Elements of a List

```
def sum(thelist):
    """Returns: the sum of all elements in thelist
    Precondition: thelist is a list of all numbers
    (either floats or ints)"""
    result = 0
    result = result + thelist[0]
    result = result + thelist[1]
    ...
    return result
```

There is a problem here

Working with Sequences

- Sequences are potentially **unbounded**
  - Number of elements inside them is not fixed
  - Functions must handle sequences of different lengths
  - **Example**: sum([1,2,3]) vs. sum([4,5,6,7,8,9,10])
- Cannot process with **fixed** number of lines
  - Each line of code can handle at most one element
  - What if # of elements > # of lines of code?
- We need a new **control structure**

For Loops: Processing Sequences

```
# Print contents of seq
x = seq[0]
print(x)
x = seq[1]
print(x)
...
x = seq[len(seq)-1]
print(x)
```

- **Remember**:
  - Cannot program …

The for-loop:

```
for x in seq:
    print(x)
```

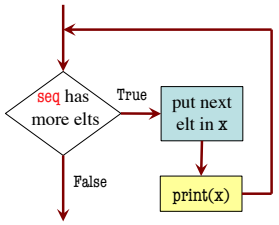
- Key Concepts
  - **loop sequence:** seq
  - **loop variable**: x
  - **body**: print(x)
  - Also called **repetend**

For Loops: Processing Sequences

The for-loop:

```
for x in seq:
    print(x)
```

- **loop sequence:** seq
- **loop variable**: x
- **body**: print(x)



To execute the for-loop:

1. Check if there is a "next" element of **loop sequence**
2. If not, terminate execution
3. Otherwise, put the element in the **loop variable**
4. Execute all of **the body**
5. Repeat as long as 1 is true

Example: Summing the Elements of a List

```
def sum(thelist):
    """Returns: the sum of all elements in thelist
    Precondition: thelist is a list of all numbers
    (either floats or ints)"""
    result = 0
    for x in thelist:
        result = result + x
    return result
```

Accumulator variable

- **loop sequence:** thelist
- **loop variable**: x
- **body**: result=result+x

For Loops and Conditionals

```
def num_ints(thelist):
    """Returns: the number of ints in thelist
    Precondition: thelist is a list of any mix of types"""
    result = 0
    for x in the list:
        if type(x) == int:
            result = result+1
    return result
```

Body

Modifying the Contents of a List

```
def add_one(thelist):
    """(Procedure) Adds 1 to every element in the list
    Precondition: thelist is a list of all numbers
    (either floats or ints)"""
    for x in thelist:
        x = x+1
    # procedure; no return
```

DOES NOT WORK!

On The Other Hand

```
def copy_add_one(thelist):
    """Returns: copy with 1 added to every element
    Precondition: thelist is a list of all numbers
    (either floats or ints)"""
    mycopy = []  # accumulator
    for x in thelist:
        x = x+1
        mycopy.append(x)  # add to end of accumulator
    return mycopy
```

Accumulator keeps result from being lost

How Can We Modify A List?

- **Never** modify loop var!
- This is an infinite loop:

```
for x in thelist:
    thelist.append(1)
```

Try this in Python Tutor to see what happens

- Need a second sequence
- How about the *positions*?

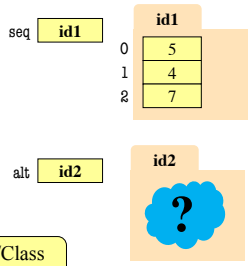
```
thelist = [5, 2, 7, 1]
thepos = [0, 1, 2, 3]

for x in thepos:
    thelist[x] = x+1
```

This is the Motivation for Iterators

- Iterators are objects
  - Contain data like a list
  - But cannot slice them
- Access data with next()
  - Function to get next value
  - Keeps going until end
  - Get an error if go to far
- Can convert back & forth
  - myiter = iter(mylist)
  - mylist = list(myiter)

Type/Class conversion



The Range Iterator

- range(x)
  - Creates an iterator
  - Stores [0,1,…,x-1]
  - **But not a list!**
  - But try list(range(x))
- range(a,b)
  - Stores [a,…,b-1]
- range(a,b,n)
  - Stores [a,a+n,…,b-1]

- Very versatile tool
- Great for processing ints

```
total = 0
# add the squares of ints
# in range 2..200 to total
for x in range(2,201):
    total = total + x*x
```

Accumulator

Modifying the Contents of a List

```
def add_one(thelist):
    """(Procedure) Adds 1 to every element in the list
    Precondition: thelist is a list of all numbers
    (either floats or ints)"""
    size = len(thelist)
    for k in range(size):
        thelist[k] = thelist[k]+1
    # procedure; no return
```

Iterator of list **positions** (safe)

WORKS!