

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
```

The for-loop:

```
for x in seq:
    print x
```

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

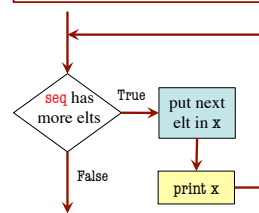
- Remember:**
 - We cannot program ...

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

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    """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 thelist:
        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!

For Loops and Frames

```
def add_one(thelist):
    """Adds 1 to every elt
    Pre: thelist is all numb."""
    1 for x in thelist:
    2   x = x+1
```

```
add_one(seq):
    thelist  id4
    x        6
```

Loop back to line 1

```
seq  id4
    0  5
    1  4
    2  7
```

Increments x in **frame**
Does not affect folder

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

For Loops: Processing Ranges of Integers

```
total = 0;
# add the squares of ints
# in range 2..200 to total
total = total + 2*2
total = total + 3*3
...
total = total + 200*200
```

The for-loop:

```
for x in range(2,201):
    total = total + x*x
```

- **The range function:**
 - **range(x):**
List of ints 0 to x-1
 - **range(a,b):**
List of ints a to b-1

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
```

WORKS!

Important Concept in CS: Doing Things Repeatedly

1. Process each item in a sequence
 - Compute aggregate statistics for a dataset, such as the mean, median, standard deviation, etc.
 - Send everyone in a Facebook group an appointment time
2. Perform *n* trials or get *n* samples.
 - **A4:** draw a triangle six times to make a hexagon
 - Run a protein-folding simulation for 10⁶ time steps
3. Do something an unknown number of times
 - CUAUV team, vehicle keeps moving until reached its goal

