CMSC201
Computer Science I for Majors
Lecture 08 – For Loops

Prof. Jeremy Dixon
Last Class We Covered

• The potential security concerns of `eval()`
• Lists and what they are used for
• How strings are represented
• How to use strings:
  – Indexing
  – Slicing
  – Concatenate and Repetition
Any Questions from Last Time?
Today’s Objectives

• To learn about and be able to use a **for** loop
  – To understand the syntax of a **for** loop
• To use a **for** loop to iterate through a list
  – Or to perform an action a set number of times
• To learn about the **range()** function
• To update our grocery program from last time!
Looping
Control Structures (Review)

- A program can proceed:
  - In sequence
  - Selectively (branching): make a choice
  - Repetitively (iteratively): looping
  - By calling a function

focus of today’s lecture
Control Structures: Flowcharts

- **a. Sequence**
  
- **b. Selection**
  
- **c. Repetition**

Focus of today’s lecture
Looping

• Python has two kinds of loops, and they are used for two different purposes

• The **for** loop:
  – Good for *iterating* over a list
  – Good for counted iterations

• The **while** loop
  – Good for almost everything else

what we’re covering today
# String Operators in Python

<table>
<thead>
<tr>
<th>Operator</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>Concatenation</td>
</tr>
<tr>
<td>*</td>
<td>Repetition</td>
</tr>
<tr>
<td>STRING[#]</td>
<td>Indexing</td>
</tr>
<tr>
<td>STRING[#:#]</td>
<td>Slicing</td>
</tr>
<tr>
<td>len(STRING)</td>
<td>Length</td>
</tr>
</tbody>
</table>

```python
for VAR in STRING
```

from last time
Review: Lists and Indexing
Review: List Syntax

• Use [] to assign initial values (*initialization*)
  ```python
  myList = [1, 3, 5]
  words  = ["Hello", "to", "you"]
  ```

• And to refer to individual elements of a list
  ```python
  >>> print(words[0])
  Hello
  >>> myList[0] = 2
  ```
Review: Indexing in a List

• Remember that list indexing starts at zero, not 1!

animals = ['cat', 'dog', 'eagle', 'ferret', 'horse', 'lizard']
print("The best animal is", animals[3])
animals[5] = "mouse"
print("The little animal is", animals[5])
print("Can a", animals[4], "soar in the sky?")
Review: Indexing in a List

animals = ['cat', 'dog', 'eagle', 'ferret', 'horse', 'lizard']
print("The best animal is", animals[3])
animals[5] = "mouse"
print("The little animal is", animals[5])
print("Can a", animals[4], "soar in the sky?")

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>cat</td>
<td>dog</td>
<td>eagle</td>
<td>ferret</td>
<td>horse</td>
<td>mouse</td>
</tr>
</tbody>
</table>
Exercise: Indexing in a List

• Using the list names, code the following:

  1. Print “Bob sends a message to Alice”
  2. Change the first element of the list to Ann
  3. Print “BobBobAnnEve”
Exercise: Indexing in a List

• Using the list `names`, code the following:

1. Print “Bob sends a message to Alice”
2. Change the first element of the list to Ann
3. Print “BobBobAnnEve”

```python
print(names[1], "sends a message to", names[0])
names[0] = "Ann"
# or     print(names[1]*2 + names[0] + names[2])
```
for Loops: Iterating over a List
def main():
    print("Welcome to the Grocery Manager 1.0")
    // initialize the value and the size of our list
    grocery_list = [None]*3

    grocery_list[0] = input("Please enter your first item: ")
grocery_list[1] = input("Please enter your second item: ")
grocery_list[2] = input("Please enter your third item: ")
print(grocery_list[0])
print(grocery_list[1])
print(grocery_list[2])
main()
Iterating Through Lists

• *Iteration* is when we move through a list, one element at a time
  – Instead of specifying each element separately, like we did for our grocery list

• Using a `for` loop will make our code much faster and easier to write
Parts of a `for` Loop

- Here’s some example code... let’s break it down

```python
myList = ['a', 'b', 'c', 'd']

for listItem in myList:
    print(listItem)
```
Parts of a **for** Loop

- Here’s some example code... let’s break it down

```python
myList = ['a', 'b', 'c', 'd']

for listItem in myList:
    print(listItem)
```

- **initialize the list**
- **how we will refer to each element**
- **the list we want to iterate through**
- **the body of the loop**
How a for Loop Works

• In the for loop, we are declaring a new variable called “listItem”
  – The loop will change this variable for us

• The first time through the loop, listItem will be the first element of the list
• The second time through the loop, listItem will be the second element of the list
• And so on...
Example for Loop

- We can use a for loop to find the average from a list of numbers

```python
nums = [98, 75, 89, 100, 45, 82]
total = 0  # we have to initialize total to zero

for n in nums:
    total = total + n  # so that we can use it here
avg = total / len(nums)
print("Your average in the class is: ", avg)
```
Quick Note: Variable Names

• Remember, variable names should always be meaningful
  – And they should be more than one letter

• There’s one exception: loop variables

  ```python
  for n in nums:
      sum = sum + n
  ```
  – You can (of course) make them longer if you want.
A Downside!

• What do you think this code does?

```python
myList = [1, 2, 3, 4]
for listItem in myList:
    listItem = 4
print("List is now:", myList)
```

- Changing `listItem` does not change the original list!
  - It’s only a copy of each element
Strings and `for` Loops

• Strings are represented as lists of characters
  – So we can use a `for` loop on them as well

```python
music = "jazz"
for c in music:
    print(c)
```

What will this code do?

• The `for` loop goes through the string letter by letter, and handles each one separately
Practice: Printing a List

• Given a list of strings called `food`, use a `for` loop to print out that each food is yummy!

```python
food = ["apples", "bananas", "cherries", "durians"]
# for loop goes here
for f in food:
    print(f, "are yummy!")
apples are yummy!
bananas are yummy!
cherries are yummy!
durians are yummy!
```
The `range()` function
Range of Numbers

- Python has a built-in function called `range()` that can generate a list of numbers

```python
a = list(range(0, 10))
print(a)
```

- Cast it to a list to force the generator to run like slicing – it's UP TO (but not including) 10

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```
Using `range()` in a `for` Loop

- We can use the `range()` function to control a loop through “counting”

```python
for i in range(0,20):
    print(i+1)
```

- What will this code do?
  - Print the numbers 1 through 20 on separate lines
Syntax of `range()`

```
range(START, STOP, STEP)
```

- the name of the function
- the number we want to start counting at
- how much we want to count by
- the number we want to count UP TO (but will not include)
Examples of `range()`

• There are three ways we can use `range()`

• With one number
  ```python
  range(10)
  ```

• With two numbers
  ```python
  range(10, 20)
  ```

• With three numbers
  ```python
  range(0, 100, 5)
  ```
range() with One Number

• If we just give it one number, it will start counting at 0, and will count UP TO that number

```python
>>> one = list(range(4))
>>> one
[0, 1, 2, 3]
```
range() with Two Numbers

- If we give it two numbers, it will count from the first number UP to the second number

```python
>>> twoA = list(range(5,10))
>>> twoA
[5, 6, 7, 8, 9]
>>> twoB = list(range(-10,-5))
>>> twoB
[-10, -9, -8, -7, -6]
>>> twoC = list(range(-5,-10))
>>> twoC
[]
```

range() can only count up!
from a lower to a higher number
range() with Three Numbers

• If we give it three numbers, it will count from the first number UP to the second number, and it will do so in steps of the third number

```python
>>> threeA = list(range(2, 11, 2))
>>> threeA
[2, 4, 6, 8, 10]
>>> threeB = list(range(3, 28, 5))
>>> threeB
[3, 8, 13, 18, 23]
```

range() starts counting at the first number!
Practice: The `range()` function

• What lists will the following code generate?

1. `prac1 = list(range(50))`
   
   
   
   `[0, 1, 2, 3, 4, 5, ..., 47, 48, 49]`
   
   a list from 0 to 49, counting by 1

2. `prac2 = list(range(-5, 5))`
   
   
   
   `[-5, -4, -3, -2, -1, 0, 1, 2, 3, 4]`

3. `prac3 = list(range(1, 12, 2))`
   
   
   
   `[1, 3, 5, 7, 9, 11]`
Counting Down with \texttt{range()} \\

- We said \texttt{range()} could only count up \\
  - But that’s not strictly true! \\
- If the \texttt{STEP} is set to a \textbf{negative} number, then \texttt{range()} can be used to count down \\
  \\
  >>> downA = list(range(10, 0, -1)) \\
  >>> downA \\
  [10, 9, 8, 7, 6, 5, 4, 3, 2, 1] \\
  >>> downB = list(range(18, 5, -2)) \\
  >>> downB \\
  [18, 16, 14, 12, 10, 8, 6]
Practice: Odd or Even?

• Write code that will print out, for the numbers 1 through 20, whether that number is even or odd

Sample output:

The number 1 is odd
The number 2 is even
The number 3 is odd
Practice: Odd or Even?

- Write code that will print out, for the numbers 1 through 20, whether that number is even or odd

```python
for num in range(1,21):
    if (num % 2):  # will be 1 (True)
        print(num, "is odd")
    else:    # divides cleanly into 2
        print(num, "is even")
```
Practice: Update our Grocery List!

• Remember from last time...
  – What would make this process easier?
  – Loops!
    • Instead of asking for each item individually, we could keep adding items to the list until we wanted to stop (or the list was “full”)

• Let’s do this!
Announcements

• Your Lab 4 is meeting normally this week!
  – Make sure you attend your correct section

• Homework 3 is out
  – Due by Thursday (Sept 24th) at 8:59:59 PM

• Homeworks are on Blackboard
  – Weekly Agendas are also on Blackboard