

CMSC201

Computer Science I for Majors

Lecture 14 – For Loops

Last Class We Covered

- Modularity
 - Meaning
 - Benefits
- Program design
 - Top Down Design
 - Top Down Implementation
 - Bottom Up Implementation



Any Questions from Last Time?

Today's Objectives

- To learn about the `range()` function
- To learn about and be able to use a `for` loop
 - To understand the syntax of a `for` loop
 - To be able to combine `range()` and `for`
- To discuss the differences between `for` loops and `while` loops

The `range()` function

Range of Numbers

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

cast it to a list to force it generate the numbers now

```
ex = list(range(0, 10))  
print(ex)
```

like slicing – it's UP TO
(but not including) 10

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

Syntax of `range()`

`range(start, stop, step)`

the name of
the function

the number we
want to start
counting at

the number we want
to count UP TO (but
will not include)

how much we
want to count by

Examples of `range()`

- There are three ways we can use `range()`
- With one number
`range(10)`
- With two numbers
`range(0, 10)`
- With three numbers
`range(0, 10, 1)`

`range ()` with One Number

- If `range ()` is given only one number
 - It will start counting at 0
 - And will count up to (but not including) that number
 - Incrementing by one

```
list(range(4))
```

```
[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

```
list(range(5, 10))
```

```
[5, 6, 7, 8, 9]
```

```
list(range(10, 5))
```

```
[]
```

`range ()` counts
up by default!

`range ()` with Two Numbers

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

```
list(range(-10, -5))
```

```
[-10, -9, -8, -7, -6]
```

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

```
list(range(2, 11, 2))
```

```
[2, 4, 6, 8, 10]
```

```
list(range(3, 28, 5))
```

```
[3, 8, 13, 18, 23]
```

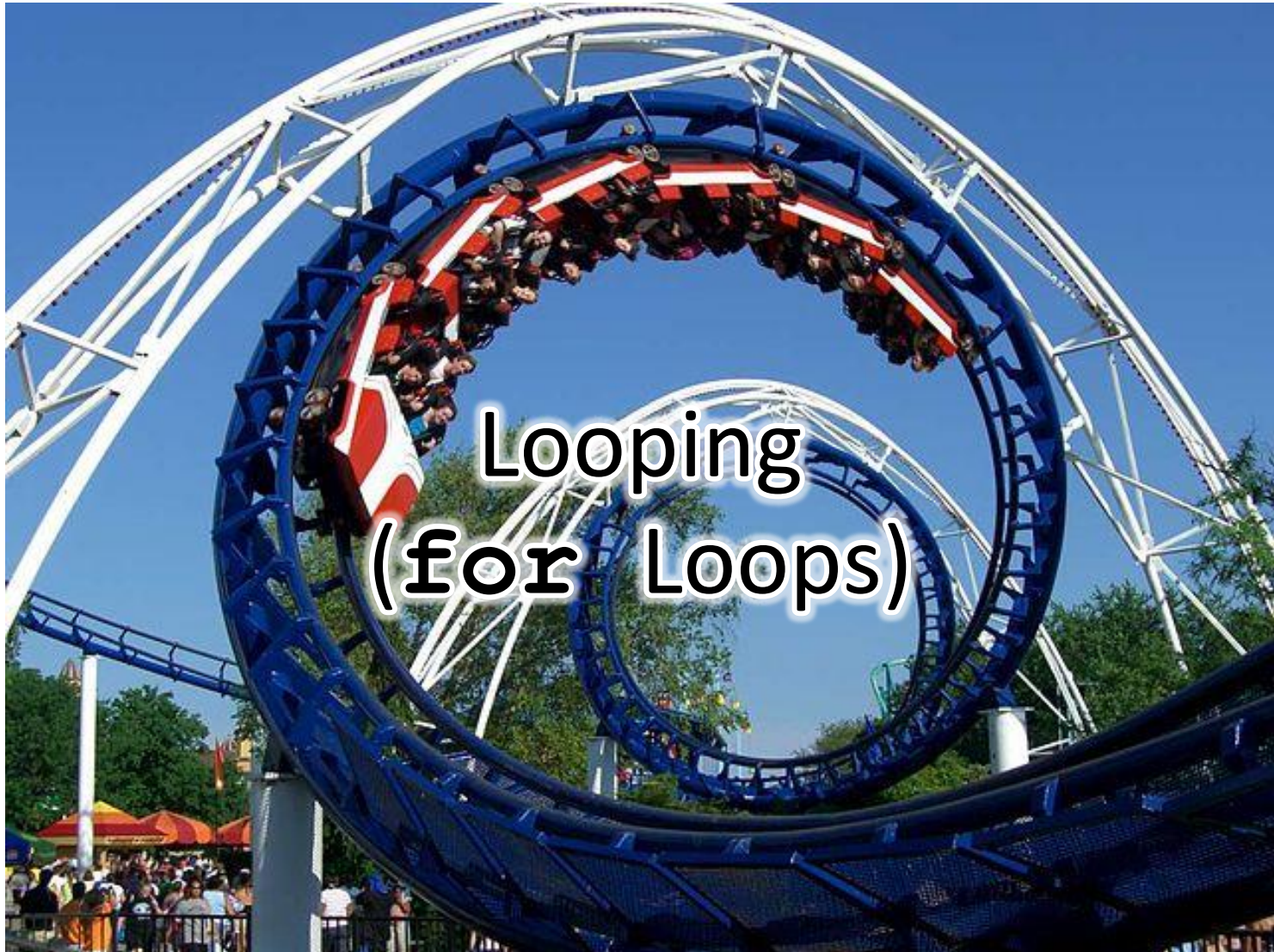
`range ()` starts counting at the first number!

Counting Down with `range()`

- By default, `range()` counts up
 - But we can change this behavior
- If the **STEP** is set to a negative number, then `range()` can be used to count down

```
list(range(10, 0, -1))
```

```
[10, 9, 8, 7, 6, 5, 4, 3, 2, 1]
```



Iterating Through Lists

- ***Iteration*** is when we move through a list, one element at a time
 - Iteration is best completed with a loop
 - We did this previously with our **while** loop
- Using a **for** loop will make our code much faster and easier to write
 - Even faster than the **while** loop was to write!

for Loops vs while Loops

- With a **while** loop, infinite loops are a common problem
 - The programmer is in charge of updating the loop variable, and can easily forget
- With **for** loops, infinite loops won't happen
 - The loop variable is updated by Python
 - It's handled "for" you!

Using `range()` in `for` Loops

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

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

- What will this code do?
 - Print the numbers 1 through 20 on separate lines
- The `for` loop is iterating over the numbers

Using `range()` in `for` Loops

- When we use the `range()` function in `for` loops, we don't need to cast it to a list
 - The `for` loop handles that for us

```
print("Counting by fives...")  
for num in range(5, 26, 5):  
    print(num)
```

```
5  
10  
15  
20  
25
```

call the `range()` function, but don't need to cast it to a list

Using `for` Loops with Lists

Using a `for` Loop with Lists

- We can combine a simple `for` loop with a list and the `range()` function, as shown below

```
for i in range( len(theList) ):
    print( theList[i] )
```

- What's the benefit to doing it this way?
- Why do we need `range()` and `len()`?
 - We'll answer these questions momentarily

Breaking It All Down

- If `theList` has a length of 8, what list does the `range()` in the `for` loop generate?

```
for i in range( len(theList) ):
    print( theList[i] )
```

- It will generate a list: `[0, 1, 2, 3, 4, 5, 6, 7]`
- What does this represent?
 - The indexes of the list `theList`

Why `range()` and `len()`?

- Why do we need `len()`?
 - To know how many indexes the list has
 - It will give us an integer value
- Why do we need `range()`?
 - To generate all the indexes of the list
- What does `range()` do with one number?
 - Start at 0, and count up to the number given

Common Error

- Pay attention with `len()` and `range()`
- Which goes on the outside?
 - `range()`
 - It needs the length to generate the indexes
- If you use them backwards:
`TypeError: 'list' object cannot be interpreted as an integer`

Time for...

LIVECODING!!!

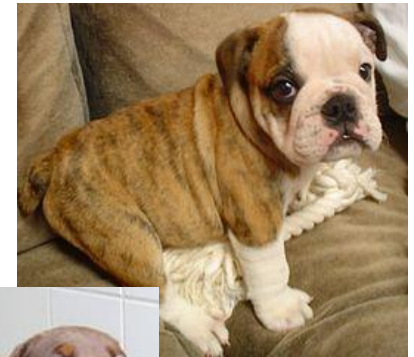
Running a Kennel

- You are running a kennel with space for 5 dogs
- You ask your 3 assistants to do the following, using the list of dogs in your office:
 1. Tell you all of the dogs in the kennel
 2. Tell you what pen number each dog is in
 3. Later, all the dogs have been picked up, and someone dropped off their 5 German Shepherds, so the list in your office needs to be updated

Running a Kennel

- The dogs in your kennel at the start are:

| | | | | |
|---------------------|--------|--------------|----------|--------------------|
| Alaskan Klee Kai | Beagle | Chow Chow | Doberman | English Bulldog |
|---------------------|--------|--------------|----------|--------------------|



Kennel Sample Output

Assistant #1:

Alaskan Klee Kai

Beagle

Chow Chow

Doberman

English Bulldog

Assistant #3:

At the end of the day:

German Shepherd

German Shepherd

German Shepherd

German Shepherd

German Shepherd

Assistant #2:

There is a Alaskan Klee Kai in kennel pen 0

There is a Beagle in kennel pen 1

There is a Chow Chow in kennel pen 2

There is a Doberman in kennel pen 3

There is a English Bulldog in kennel pen 4

Using Loops to Make 2D Lists

- The easiest way to create a 2D list is to ...?
 - Start with an empty one-dimensional list
 - Create the first “row” as a separate list
 - Append it to the original 1D list
 - Repeat until all rows are added to the list
- You can use a **while** loop, but **for** loops are great at creating lists of a specific size

Example: Creating 2D List

- Create a 6-high by 4-wide list of underscores

```
row = []  
for i in range(4):  
    row.append("_")
```

```
board = []  
for i in range(6):  
    board.append( row[:] )
```

why is this here?

each row needs to be individual, hence it needs to be deep copied

Example: Creating 2D List from Input

- Create a list of names and majors for 5 students

```
info = []
```


```
for i in range(5):
```

```
    name = input("Enter name: ")
```

```
    major = input("Major? ")
```

```
    row = [name, major]
```

```
    info.append(row)
```



why doesn't this row need to be deep copied?

Daily CS History

- Grace Hopper
 - Popularized the term “computer bug”
 - Invented the COBOL language
 - Invented one of the first compilers
 - US Navy Rear Admiral
 - Retired at the age of 79



Announcement: Advising

- CMSC and CMPE students, sign up for an advising appointment
 - <http://advising.coeit.umbc.edu/registration/>
- Select that you are in MATH 150 or higher and haven't completed the gateway
- There are both group advising and individual advising appointments open. The earliest dates available are for group advising

Announcements

- Project 1 is out on Blackboard now
 - **Design** is due by Friday (Mar 30th) at 8:59:59 PM
 - Design is provided, but you must still think about it carefully to figure out how everything fits together!
 - **Project** is due by Friday (Apr 6th) at 8:59:59 PM
- Final exam is Friday, May 18th from 6 to 8 PM

Image Sources

- Rollercoaster:
 - [https://commons.wikimedia.org/wiki/File:Corkscrew_\(Cedar_Point\)_01.jpg](https://commons.wikimedia.org/wiki/File:Corkscrew_(Cedar_Point)_01.jpg)
- Dog images:
 - <https://commons.wikimedia.org/wiki/File:WOWAKK-Kukai-Alaskan-Klee-Kai.jpg>
 - https://commons.wikimedia.org/wiki/File:Cute_beagle_puppy_lilly.jpg
 - https://commons.wikimedia.org/wiki/File:01_Chow_Chow.jpg
 - <https://commons.wikimedia.org/wiki/File:Dobermannwurf.jpg>
 - https://commons.wikimedia.org/wiki/File:English_Bulldog_puppy.jpg
- Grace Hopper (adapted from):
 - [https://en.wikipedia.org/wiki/File:Commodore_Grace_M._Hopper,_USN_\(covered\).jpg](https://en.wikipedia.org/wiki/File:Commodore_Grace_M._Hopper,_USN_(covered).jpg)