CSCI 127: Joy and Beauty of Data

Lecture 7: Lists

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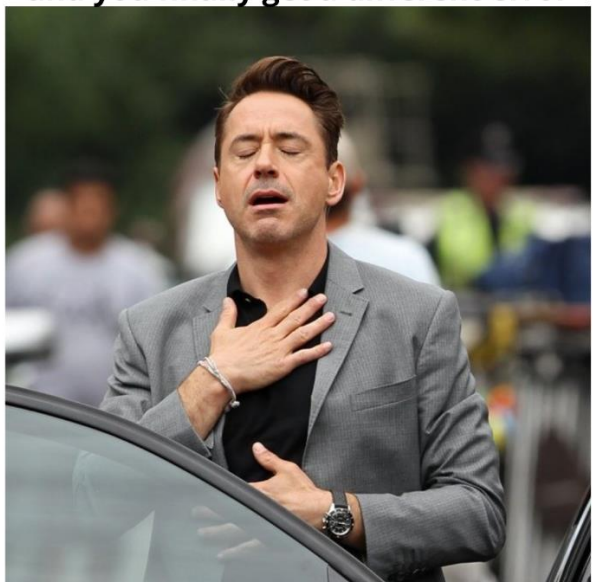
Summer 2021

https://reesep.github.io/summer2021/classes/127/main.html

Announcements

When you stare at your code for 2 hours and you finally get a different error



- Lab 3 due tomorrow (Thursday) @ 11:59 PM
- Program 1 Due Sunday @ 11:59 PM
- I am currently grading Lab 2
- Lab 4 due ~~Monday~~ Tuesday @ 11:59 PM
  -> After today, you will be able to finish it

Today

Intro to lists, example programs using lists

Lists

A **list** is an ordered collection of items (elements)

Usually denoted by square brackets [ ]

```
names = ["Reese", "Jane", "Jeff"]
```

Can be of any data types

```
course = ["CSCI", 127, "Snowmester"]
```

Lists Index

List elements are ordered by their **index**

```
names = ["Reese", "Jane", "Jeff", "Tim"]
```

We can access specific elements of the list by providing the index of the element we want

```
print( names[0] )   → Reese
print( names[1] )   → Jane
print( names[3] )   → Tim
print( names[4] )   → Error
```

(index 4 does not exist!)

```
print( names[-1] )  → Tim
print( names[-2] )  → Jeff
```

List Size

We can get the size/length of a list by using the **`len()`** function

```
names = [“Reese”, ”Jane”, ”Jeff”, “Tim”]
print( len(names) ) → 4


primes =[2, 3, 5, 6, 7, 11, 13, 17, 19]
print( len(primes) ) → 9
```

List Size

We can get the size/length of a list by using the **`len()`** function

```
names = [“Reese”, ”Jane”, ”Jeff”, “Tim”]
print( len(names) ) → 4


primes =[2, 3, 5, 6, 7, 11, 13, 17, 19]
print( len(primes) ) → 9
```

List Concatenation

We can concatenate lists together using the + operator

```
new_list = [1, 2, 3] + [“a”, ”b”, ”c”]
print(new_list)
```

Output

```
[1, 2, 3, “a”, ”b”, ”c”]
```

List Repetition

We can repeat lists using the * operator

```
new_list = [1, 2, 3] * 3
print(new_list)
```

Output

```
[1, 2, 3, 1, 2, 3, 1, 2, 3]
```

List Membership

We can check to see if something is in a list using **in** and **not in**

```
cities = [“Billings”, “Bozeman”, “Butte”, “Helena”, “Missoula”]
```

```
print( “Billings” in cities  )          True

print( “Red Lodge” in cities )          False

print( “bozeman” in cities )            False

print( “Butte” not in cities)           False

print( “Deer Lodge” not in cities)      True
```

List Mutability

Lists are **mutable** (we can change things in the list)

```
date = [“December”, 9, 2020]
```

0 1 2

```
print(date)

date[1] = 10

print(date)

date[2] = “2020”

print(date)
```

Output

```
[“December”, 9, 2020]
[“December”, 10, 2020]
[“December”, 10, “2020”]
```

List Slicing

We can access specific “slices” of lists using list slicing

```
                0          1          2          3          4
cities = [“Billings”, “Bozeman”, “Butte”, “Helena”, “Missoula”]
```

```
cities[1:3]  →   [“Bozeman”, “Butte”]
cities[0:4] →   [“Billings”, “Bozeman”, “Butte”, “Helena”]
cities[2:3] →   [“Butte”]
cities[1:-1] → [“Bozeman”, “Butte”, “Helena”]
```

```
list_name[X:Y]
```

Get slice from X to Y but not including Y

Adding Element to list

We can add items to lists using **.append()** or **.insert()**

.append(*item*)

Add *item* to the end of the list

```
days = [“Mon”, “Tue”, “Wed”]

print(days)

days.append(“Thurs”)

print(days)
```

Output

```
[“Mon”, “Tue”, “Wed”]

[“Mon”, “Tue”, “Wed”, “Thurs”]
```

.insert(position, *item*)

Add *item* to specific index to list

```
days = [“Mon”, “Tue”, “Wed”]

print(days)

days.insert(1,“Thurs”)

print(days)
```

Output

```
[“Mon”, “Tue”, “Wed”]

[“Mon”, “Thurs” “Tue”, “Wed”]
```

Removing Items from Lists

We can remove items from lists using **.pop()** or **.remove()**

.pop(*index*) or .pop()

Removes item at specific index.
If index is not specified, then it will remove the last element in the list.

```
days = [“Mon”, “Tue”, “Wed”]

print(days)

days.pop(1)

print(days)

days.pop()

Print(days)
```

Output

```
[“Mon”, “Tue”, “Wed”]

[“Mon”, “Wed”]

[“Mon”]
```

.remove(item)

Will search through list for specific item and remove it

```
days = [“Mon”, “Tue”, “Wed”]

print(days)

days.remove(“Tue”)

print(days)
```

Output

```
[“Mon”, “Tue”, “Wed”]

[“Mon”,“Wed”]
```

Counting frequency in lists

We can count the number of times an item appears in a list using **.count()**

```
scores = [100,99,81,72,100,34,86,92,100,100,66]
```

To print out the number of times **100** occurs in the list, we can do:

```
print(scores.count(100))   → 4
```

Sorting a List

We can sort elements in a list using .sort()

```
scores = [100,99,81,72,100,34,86,92,100,100,66]

print(scores)

scores.sort()

print(scores)
```

Output

```
[100, 99, 81, 72, 100, 34, 86, 92, 100, 100, 66]

[34, 66, 72, 81, 86, 92, 99, 100, 100, 100, 100]
```

Sorted least to greatest!

Sorting a List

We can sort elements in a list using .sort()

```
words = [“Cat”, “Dog”, “Apple” ,”Banana”]

print(words)

words.sort()

print(words)
```

Output

```
[“Cat”, “Dog”, “Apple” ,”Banana”]

[“Apple”, ”Banana”, “Cat”, “Dog”]
```

Sorted alphabetically!

Reversing a List

We can reverse a list using .reverse()

```
words = [“Cat”, “Dog”, “Apple” ,”Banana”]

print(words)

words.reverse()

print(words)
```

Output

```
[“Cat”, “Dog”, “Apple” ,”Banana”]

[“Banana”, “Apple”, “Dog”, “Cat”]
```

List has been reversed!

Iterating through items in a list

We can iterate through a list using a for loop in two different ways

By Element:

```
words = [“Cat”, “Dog”, “Apple” ,”Banana”]
for each_word in words:
   print(words)
```

By Position/Index:

```
words = [“Cat”, “Dog”, “Apple” ,”Banana”]
for i in range(len(words)):
   print(words[i])
```

Example

Write a python function that will take in a list of test scores (of any size) and returns the average of those exam scores

Write a python function that will take in a list of words and return a list with all duplicate words removed

Write a python function that will return the largest value in a list. Next, generate a list of a random size (between 10 and 20) that is filled with random integers between 1 and 1000 and pass it into the function you created

One more Example

The variable scores contains scores of each 2017 MSU football game.

Complete the program so that MSU'S wins and losses are computed, regardless of the number of games played

```
scores = [0, 31, 27, 31, 49, 21, 17, 25]  #[msu-score-1, opponent-score-1, msu-score2,
                                          # opponent-score2, …]

## The missing code goes here. Assume that every game results in either a win or loss

print("MSU has", wins, "win(s) and", losses," loss(es)")
```

Announcements (Thursday)

Lab 3 due **TONIGHT** @ 11:59 PM

Program 1 due Sunday @ 11:59 PM

Lab 4 due Monday@ 11:59 PM

After today, you will be able to start and finish Program 2 ☺

Today

More on lists, nested lists

Creating a list from a string

A list can be created from a string using **`.split()`**

```
declaration = "Four score and seven years ago"
x = declaration.split()
print(x)
print(type(x))
print(len(x))
```

Output

```
['Four', 'score', 'and', 'seven', 'years', 'ago']
<class 'list'>
6
```

```
declaration = "Four score and seven years ago"
x = declaration.split("and")
print(x)
print(type(x)
print(len(x))
```

Output

```
['Four score', 'seven years ago']
<class 'list'>
2
```

Creating a string from a list

A string can be created from a list using **`.join()`**

```
seuss = [“green”,”eggs”,”and”,”ham”]
glue = “*”
glue = glue.join(seuss)
print(glue)
print(type(glue))
```

Output

```
'green*eggs*and*ham’
<class ‘str’>
```

```
seuss = [“green”,”eggs”,”and”,”ham”]
space = “ ”
space = space.join(seuss)
print(space)
print(type(space))
```

Output

```
‘green eggs and ham’
<class ‘str’>
```

Tuple

A tuple is like a list, except it is immutable (you cannot change the elements inside them)

```
today = (“Thursday”,”December”,10)
print(type(today))
print(today[0])
today[0] = “Friday”
```

Tuples use parenthesis, not square brackets

Trying to change an element of a tuple results in an error

Output

```
'green*eggs*and*ham’
<class ‘tuple’>
Thursday

TypeError: 'tuple' object does not support item assignment
```

You can easily convert a tuple to be a list:

```
today = list(today)
```

Nested Lists

You can have lists inside of lists

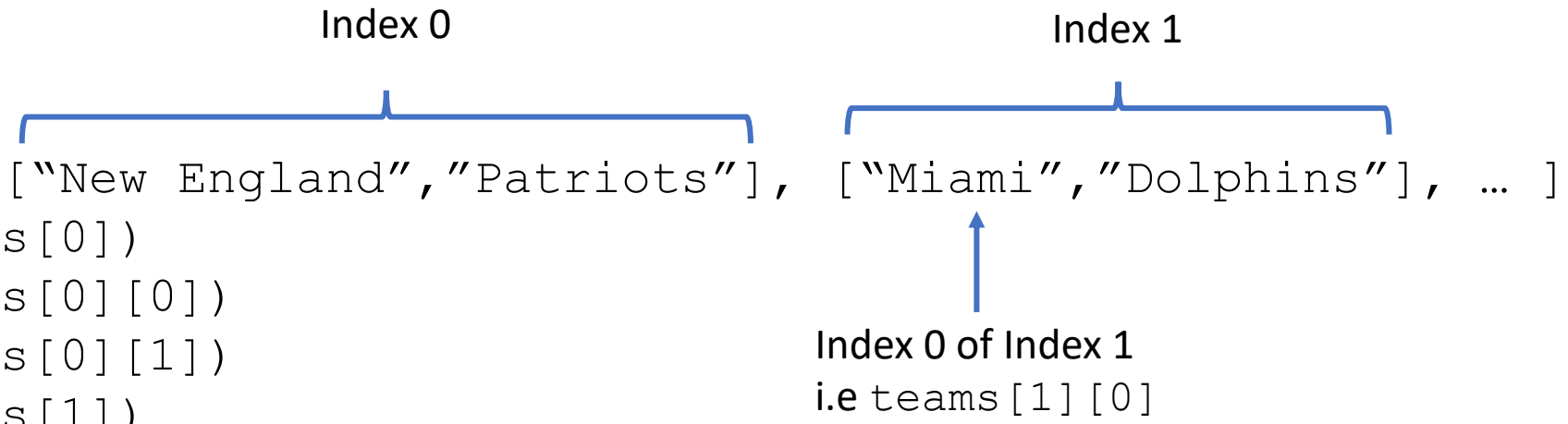
```
teams = [ [“New England”,”Patriots”], [“Miami”,”Dolphins”], … ]
print(teams[0])
print(teams[0][0])
print(teams[0][1])
print(teams[1])
print(teams[1][1])
```

Output

```
['New England', 'Patriots']
New England
Patriots
['Miami', 'Dolphins']
Dolphins
```

Nested Lists

You can have lists inside of lists



Output

```
['New England', 'Patriots']
New England
Patriots
['Miami', 'Dolphins']
Dolphins
```

Nested List Example

Consider the nested list that contains 2013 census population information when the total population was **316,128,839**

```
populations =
[["California", 38332521],
["Texas", 26448193],
["New York", 19651127],
["Florida", 19552860],
["Illinois", 12882135],
["Pennsylvania", 12773801],
["Ohio", 11570808],
["Georgia", 9992167],
["Michigan", 9895622],
["North Carolina",9848060]]
```

Write a function that calculates and returns the total population of the list

Write a function that also prints the percentage of the U.S. population that lives in each of the 10 most populated states

If time persists:

- modify the `populations` list to include information about whether each state is landlocked (`True` or `False`)
- Calculate and print the percentage of the population in the 10 most populated states that lives in a landlocked state

Nested List Example

Consider the nested list that contains information about super bowl champions since 2000

```
champions =[
    [2000,"St. Louis Rams"],[2001,"Baltimore Ravens"],
    [2002,"New England Patriots"], [2003,"Tampa Bay Buccaneers"],
    [2004,"New England Patriots"], [2005,"New England Patriots"],
    [2006,"Pittsburgh Steelers"], [2007,"Indianapolis Colts"],
    [2008,"New York Giants"], [2009,"Pittsburgh Steelers"],
    [2010,"New Orleans Saints"], [2011,"Green Bay Packers"],
    [2012,"New York Giants"], [2013,"Baltimore Ravens"],
    [2014,"Seattle Seahawks"], [2015,"New England Patriots"],
    [2016,"Denver Broncos"], [2017,"New England Patriots"],
    [2018,"Philadelphia Eagles"], [2019,"New England Patriots"],
    [2020,"Kansas City Chiefs"], [2021,"Tampa Bay Buccaneers"]
    ]
```

Write a function that will print out any back-to-back (consecutive) super bowl champions

If time persists:

- Write a function that will ask the user for a team name, and then print out how time that team has won the super bowl since 2000