Strings

Strings

- Basic data type in Python
  - Strings are immutable, meaning they cannot be shared
    - Why?
      - It’s complicated, but string literals are very frequent. If strings cannot be changed, then multiple occurrences of the same string in a program can be placed in a single memory location.
      - More importantly, strings can serve keys in key-value pairs.
- Don’t worry, we are going to see what this means.

String Literals

- String literals are defined by using quotation marks
  - Example:

```
>>> astring = "Hello World"
>>> bstring = 'Hello World'
>>> astring == bstring
True
```

- To create strings that span newlines, use the triple quotation mark

```
>>> cstring = """This is a very
complicated string with a few
line breaks."""
>>> cstring
'This is a very\ncomplicated string with a few\nline breaks.'
```

String Methods

- There are a number of methods for strings. Most of them are self-explaining
  - `s.lower(), s.upper()` : returns the lowercase or uppercase version of the string
  - `s.strip()`: returns a string with whitespace removed from the start and end
  - `s.isalpha()/s.isdigit()/s.isspace()`: tests if all the string chars are in the various character classes
  - `s.startswith('other'), s.endswith('other')` : tests if the string starts or ends with the given other string
  - `s.find('other')` : searches for the given other string (not a regular expression) within s, and returns the first index where it begins or -1 if not found
  - `s.replace('old', 'new')`: returns a string where all occurrences of 'old' have been replaced by 'new'

Strings and Characters

- Python does not have a special type for characters
  - Characters are just strings of length 1.

Accessing Elements of Strings

- We use the bracket notation to gain access to the characters in a string
  - a_string[3] is character number 3, i.e. the fourth character in the string

String Processing

- Since strings are immutable, we process strings by turning them into lists, then processing the list, then making the list into a string.
  - String to list: Just use the list-command

```
>>> a_string = "Milwaukee"
>>> list(a_string)
['M', 'i', 'l', 'w', 'a', 'u', 'k', 'e', 'e']
```

String Processing

- Turn lists into strings with the join-method
  - The join-method has weird syntax
    - `a_string = “”.join(a_list)`
      - The method is called on the empty string “”
      - The sole parameter is a list of characters or strings
- You can use another string on which to call join
  - This string then becomes the glue

```
gluestr.join([str1, str2, str3, str4, str5])
```

String Processing

- Examples

```
>>> a_list = ['M', 'a', 'h', 'a', 'r', 'a', 's', 'h', 't', 'r', 'a']
>>> "".join(a_list)
'Maharashtra'
>>> " ".join(a_list)
'M a h a r a s h t r a'
>>> "_".join(a_list)
'M_a_h_a_r_a_s_h_t_r_a'
>>> "oho".join(a_list)
'Mohoaohohohoaohorohoaohosohohohotohorohoa'
```

String Processing

- Procedure:
  - Take a string and convert to a list
  - Change the list or create a new list
  - Use join to recreate a new string

- Alternative Procedure:
  - Build a string one by one, using concatenation (+ -operator)
  - Creates lots of temporary strings cluttering up memory
    - Which is bad if you are dealing with large strings.

String Processing

- Example: Given a string, change all vowels to increasing digits.
  - This is used as a (not very secure) password generator
  - Examples:
    - `Wisconsin -> W1sc2ns3n`
    - `AhmedabadGujaratIndia -> 1hm2d3b4dG5j6r7t8nd90`

String Processing

- Implementation:
  - Define an empty list for the result
  - We return the result by changing from list to string

```
def pwd1(string):
    result = [ ]


    return "".join(result)
```

String Processing

- Need to keep a counter for the digits

```
def pwd1(string):
    result = [ ]
    number = 1
```

String Processing

- Now go through the string with a for statement
- Create the list that will be returned converted into a string

```
def pwd1(string):
result = [ ]
number = 1
for character in string:

#append to result here


return "".join(result)
```

String Processing

- We either append the letter from the string or we append the current integer, of course cast into a string

```
def pwd1(string):
    result = [ ]
number = 1
for character in string:
    if character not in "aeiouAEIOU":
        result.append(character)
    else:
        result.append(str(number))
        number = (number+1)%10
return "".join(result)
```

String Processing

- Argot
  - A variation of a language that is not understandable to others
    - E.g. Lufardo — an argot from Buenos Aires that uses words from Italian dialects
      - Invented originally to prevent guards from understanding the inmates
      - Some words are just based on changing words
        - vesre - al reves (backwards)
        - chochamu - vesre for muchacho (chap)
        - lorca - vesre for calor (heat)

String Processing

- Argot
  - Pig Latin
    - Children’s language that uses a scheme to change English words
    - Understandable to practitioners, but not to those untrained

String Processing

- Argot:
  - Efe-speech
    - A simple argot from Northern Argentina no longer in use
    - Take a word: “muchacho”
    - Replace each vowel with a vowel-f-vowel combination
    - “Muchacho” becomes Mufuchafachofo
    - “Aires” becomes “Afaifirefes”

String Processing

- Implementing efe-speech
  - Walk through the string, modifying the result list

```
def efe(string):
    result = [ ]
    for character in string:
        result.append(SOMETHING)
    return "".join(result)
```

String Processing

- We need to be careful about capital letters
  - We can use the string method lower
    - Which you find with a www-search

```
def efe(string):
    result = [ ]
    for character in string:

        elif character in "AEIOU":
            result.append(character+'f'+character.lower())

    return "".join(result)
```

String Processing

```
def efe(string):
    result = [ ]
    for character in string:
        if character in "aeiou":
            result.append(character+'f'+character)
        elif character in "AEIOU":
            result.append(character+'f'+character.lower())
    else:
        result.append(character)
return "".join(result)
```

String Processing

```
>>> efe("Alejandria")
'Afalefejafandrifiafa'
>>>
```

Slices

- We already know two sequence types: lists and strings
  - Sequences can be sliced: A slice is a new object of the same type, consisting of a subsequence
  - Use a bracket cum colon notation to define slices.
    - sequence[a:b] are all elements starting with index a and stoping before index b.

Slices

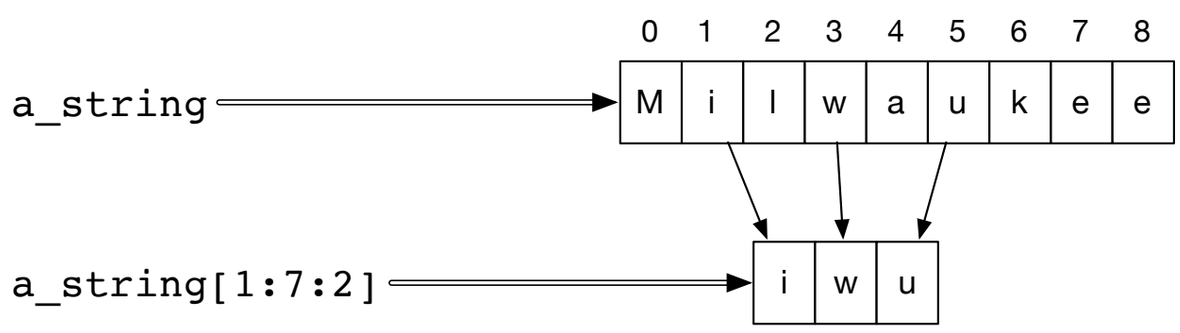
- String slices
  - Number before colon:
    - Start
  - Number after colon:
    - Stop
  - Default value before colon:
    - Start with first character
  - Default value after colon
    - End with the string

```
>>> a_string = "Milwaukee"
>>> a_string[3:6]
'wau'
>>> a_string[1:5]
'ilwa'
>>> a_string[:6]
'Milwau'
>>> a_string[4:]
'aukee'
```

Slices

- String slices:
  - Optional third parameter is Stride
    - First character is character 1
    - Next one is character 1+2
    - Next one is character 1+2+2
    - Next one would be character 1+2+2+2, but that one is >= the stop value.

```
>>> a_string = "Milwaukee"
>>> a_string[1:7:2]
'iwu'
```



start value is index 1

stop value is index 7

stride is 2

Slices

- Negative strides are allowed.
  - Create a new string that is reversed using default values

```
>>> a_string = "Milwaukee"
>>> b_string = a_string[::-1]
>>> b_string
'eekuawliM'
```

Slices

- Negative strides are allowed

```
>>> a_string = "Ahmedabad, Gujarat, India"
>>> a_string[20:3:-3]
'ItaGda'
```

- Character 20 is “I” of India
- Next character is 17, the “t” in Gujarat
- Stop before character 3 (the fourth character)

Ahmedabad, Gujarat, India

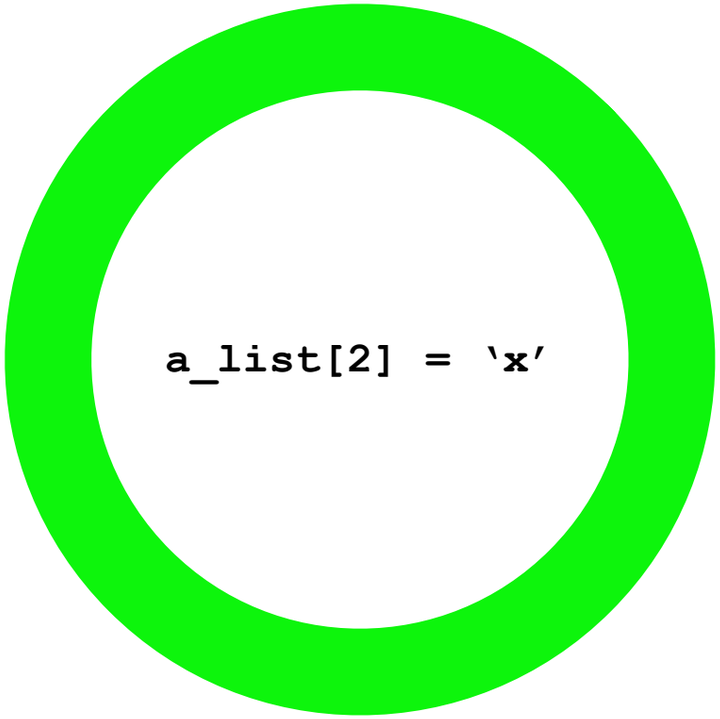
Lists and Strings

- Both lists and strings are sequences
  - Length: `len(a_string), len(a_list)`
  - Concatenation: `a_string + b_string, a_list + b_list`
  - Repetition: `3*a_string, 3*a_list`
  - Membership: `if 'x' in a_string, if a in a_list`
  - Iteration: `for ele in a_string, for ele in a_list`

Lists and Strings

- Strings are immutable

- Lists are mutable



Activities 1

- Write a program that checks (returns True/False) whether a string ends with .edu
  - one solution with endswith
  - one solution using a slice and comparing strings
  - one solution using indices and comparing characters

Activities 1 Solutions

```
def check1(a_string):
    return a_string.endswith('.edu')

def check2(a_string):
    return a_string[-4:] == '.edu'
```

```
def check3(a_string):
    return (a_string[-4] == '.' and a_string[-3] == 'e' and
            a_string[-2] == 'd' and a_string[-1] == 'u')
```

Activities 2

- A function counter that counts the number of consonants in a string

Activities 2 Solutions

```
def cons(a_string):
    count = 0
    for letter in a_string:
        if letter.lower() in 'bcdfghjklmnpqrstvwxyz':
            count += 1
    return count
```

Activities

- A function that removes all vowels in a string

Activities 3 Solutions

```
def rem_vol(a_string):
    result = [ ]
    for letter in a_string:
        if letter not in 'aeiouAEIOU':
            result.append(letter)
    return ''.join(result)
```