CONCEPTS OF PROGRAMMING

MPCS 50101
AUTUMN 2019
SESSION 5

THE UNIVERSITY OF CHICAGO

CLASS NEWS

CLASS NEWS

- I have set up an #office-hours channel to keep everyone updated on any changes to schedule and so that you can let the instructors know if you are planning to attend. If you are planning to attend, please drop a quick note in here so that they can plan accordingly.

- Unless it is a *personal issue*, please use the appropriate channels for questions and do not DM/email the instructors. Seeing questions and answers from other students and instructors will benefit everyone. From now on, we will ask you to repost these questions in the appropriate channels if needed.

CLASS NEWS

- Homework…
- `if 😱: print "It's OK"`
- We are rolling out material in the best way for you to learn (eg. recursion)

CLASS NEWS

```
# Unix challenge 1
tar -c -f mytar.tar file1.py file2.py
tar -c -f mytar.tar *.py
tar -cf mytar.tar *.py
```

CLASS NEWS

```
# With compression
tar -c -f mytar.tar *.py
tar -cfz mytar.tar.gz *.py
```

-z (c mode only) Compress the resulting archive with gzip(1). In extract or list modes, this option is ignored. Note that, unlike other **tar** implementations, this implementation recognizes gzip compression automatically when reading archives.

-Z (c mode only) Compress the resulting archive with compress(1). In extract or list modes, this option is ignored. Note that, unlike other **tar** implementations, this implementation recognizes compress compression automatically when reading archives.

CLASS NEWS

```
# Unix challenge 2
grep "#" *.py > comments.txt

# Note the |
cat *.py | grep "#" > comments.txt

# Note the ! (Overwrite)
cat *.py | grep "#" >! comments.txt
```

CLASS NEWS

- Tips, tricks and suggestions
  - Use a placeholder variable

```
# Comment this out while developing
# number_string = raw_input("> Enter a
number: ")
# number = int(number_string)

number = 20

# Work on logic
total = number * 10000
```

CLASS NEWS

- Pseudocode
- An informal high-level description of the operating principle of a computer program or other algorithm
- Uses the structural conventions of a program; intended for human reading

```
# set total to zero
total = 0

def total_some():
  # total the stuff

  # loop through all the inputs

  #  add each one to the current total

  return total
```

TRY THIS

TRY THIS

```
# Double your money
number_string = input("> Enter a number: ")
number = int(number_string)

print "The number doubled is ",
print number * 2



# % python workspace.py
# > Enter a number: 3
# The number doubled is  6
```

TRY THIS

```
# Double your money
number_string = input("> Enter a number: ")
number = int(number_string)
print "The number doubled is ",
print number * 2


# > Enter a number: three

Traceback (most recent call last):
  File "workspace.py", line 4, in <module>
    number = int(number_string)
ValueError: invalid literal for int() with base 10: 'three'
```

TRY THIS

- Exception handling
- An exception is an error that happens during execution of a program
- Python can generate an exception that can be handled, which avoids your program to crash

```
try:
    # Something that might
    # not work
except:
    print "Trouble"
```

TRY THIS

- Surround section of code with `try` and `except` block
- If the code in the try works
  - `except` is skipped
- If the code in the try fails
  - It jumps to the except section

```
try:
    # Something that might
    # not work
except:
    print "Trouble"
```

TRY THIS

- Exceptions are safer ways for handling errors and special conditions
- Exception built into standard library
- You can write your own

```
Traceback (most recent call
last):
  File "workspace.py", line
4, in <module>
    number =
int(number_string)


ValueError: invalid literal
for int() with base 10:
'three'
```

TRY THIS

```
# Double your money
number_string = input("> Enter a number: ")

try:
    number = int(number_string)
    print "The number doubled is ",
    print number * 2

except:
    print "We couldn't convert the number to an integer."
```

TRY THIS

```
# Double your money
number_string = input("> Enter a number: ")

try:
    number = int(number_string)
    success = True
except:
    success = False
    print "We couldn't convert the number to an integer"

if success == True:
    print "The number doubled is ",
    print number * 2
```

ISOLATES THE CODE THAT WE ARE "TRYING"

SET A FLAG

STRATEGY FOR CONTINUING EXECUTION EVEN IF FAILS

TRY THIS

```
# Double your money
number_string = input("> Enter a number: ")

try:
    number = int(number_string)
    print "The number doubled is ",
    print number * 2

except:
    print "We couldn't convert the number to an integer."
```

TRY THIS

```
Traceback (most recent call
last):
  File "workspace.py", line
4, in <module>
    number =
int(number_string)


ValueError: invalid literal
for int() with base 10:
'three'
```

```
try:
    f = open('myfile.txt')
    s = f.readline()
    i = int(s.strip())
except OSError as err:
    print("OS error: {0}".format(err))
except ValueError:
    print("Could not convert data to an integer.")
except:
    print("Unexpected error:", sys.exc_info()[0])
```

CHECK FOR SPECIFIC ERRORS

TRY THIS

```
number_string = input("> Enter a number: ")

try:
    number = int(number_string)
except ValueError:
    print "We couldn't convert the number to an integer."
else:
    print "The number doubled is ", number * 2
finally:
    print "-- Done --"
```

OPTIONAL;
ALWAYS RUN

DATA STRUCTURES

DATA STRUCTURES

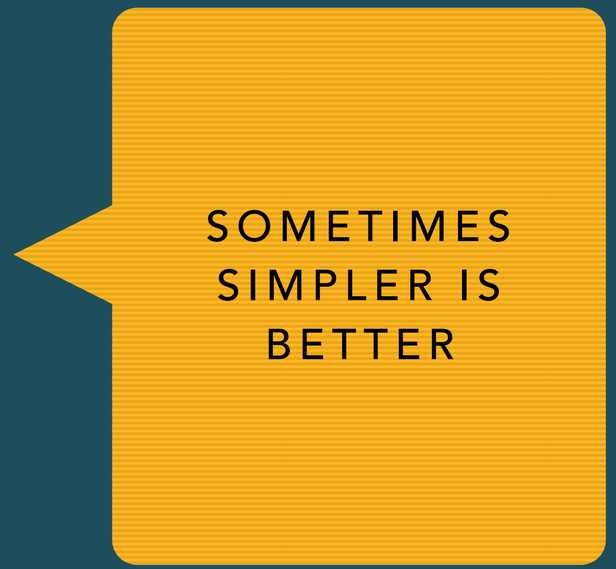
- Data structures allow the storage of data in a consistent manner
- Types of data structures
  - Built-in collection types:
    - lists (arrays), dictionaries (hashes), tuples, sets
  - Custom types:
    - Define your custom data types specific to your programs specification

DATA STRUCTURES

```
# Built-in collection list
myList = [5, 4, 3, 2, 1]



# Custom data structure
class Particle:
    def __init__(self, mass, position, velocity, force):
        self.mass = mass
        self.position = position
        self.velocity = velocity
        self.force = force

particle = Particle(2, 3, 3, 8)
```

DATA STRUCTURES

- What is the best type of data structure to use?
- It depends
  - Task
  - Complexity
  - Development time



LISTS

LISTS

- List constants are surrounded by square brackets
- The elements in the list are separated by commas

```
# List of strings
friends = [ 'Lola', 'Jane', 'Rachel']

# List of integers
favorite_numbers = [ 1, 2, 3, 4, 5]

# List iteration
dogs = [ 'spot', 'underdog', 'snooopy']
for dog in dogs:
    print dog,

>>> spot, underdog, snooopy
```

LISTS

- A list element can be any Python object
  - Even another list

```
# List of strings
cats = [ 'garfield', 'lola', 'scaredy']
dogs = [ 'spot', 'underdog', 'snooopy']

# List of lists
pets = [ cats, dogs ]

>>> pets
[['garfield', 'lola', 'scaredy'],
['spot', 'underdog', 'snooopy']]
```

LIST OF LISTS

LISTS

- Iterating through a list of lists

```
cats = [ 'garfield', 'lola', 'scaredy']
dogs = [ 'spot', 'underdog', 'snooopy']
pets = [ cats, dogs ]


# Loop through the list of lists
for pet in pets:

 # The iteration variable is a list
 for animal in pet:
    print animal,


>>> [['garfield', 'lola', 'scaredy'],
     ['spot', 'underdog', 'snooopy']]
```

LISTS

```
for pet in pets:
    print type(pet)

    if isinstance(pet, list):
        for animal in pet:
            print animal,
```

REMEMBER A LIST CAN CONTAIN DIFFERENT TYPES

```
<type 'list'>
['garfield', 'lola', 'scaredy']
<type 'list'>
['spot', 'underdog', 'snooopy']
```

LISTS

- Access the elements of list by their index

```
cats = [ 'garfield', 'lola', 'scaredy']
dogs = [ 'spot', 'underdog', 'snooopy']
pets = [cats, dogs]

print pets[0]     # cats list
print pets[0][0]  # garfield
print pets[0][1]  # lola

print pets[1]     # dogs list
print pets[1][1]  # underdog
```

LISTS

- If an index has a negative value, it counts backward from the end

```
cats = [ 'garfield', 'lola', 'scaredy']

print cats[-1] # scaredy

print cats[-2] # lola

print cats[-3] # garfield
```

LISTS

- Any integer expression can be used as an index

```
cats = [ 'garfield', 'lola', 'scaredy']

x = 1
print cats[x+1] # scaredy
```

LISTS

- IndexError if you try to read or write an element that does not exist

```
cats = [ 'garfield', 'lola', 'scaredy']
index = 4

print cats[index]
```

```
Traceback (most recent call last):
  File "workspace.py", line 4, in
<module>
    cats[4]
IndexError: list index out of range
```

LISTS

- The `range()` function returns a list of numbers that range from zero to one less than the parameter
- Take 1 or 2 parameters

```
for i in range(len(cats)):
    print "#", i,"->",cats[i]
# 0 -> garfield
# 1 -> lola
# 2 -> scaredy

for i in range(0,len(cats)):
    print "#", i,"->",cats[i]
# 0 -> garfield
# 1 -> lola
# 2 -> scaredy

for i in range(1,len(cats)):
    print "#", i,"->",cats[i]
# 1 -> lola
# 2 -> scaredy
```

LISTS

- List are mutable

```
cats = [ 'garfield', 'lola', 'scaredy']
print cats
# >>> ['garfield', 'lola', 'scaredy']


# Mutate the value of the value at
# index 1
cats[1] = 'tom'

print cats
# >>> ['garfield', 'tom', 'scaredy']
```

LISTS

- Strings are not mutable

```
name = 'Ada'
print name[0] # A

name[0] = "B"
```

```
Traceback (most recent call last):
  File "workspace.py", line 11, in
<module>
    name[0] = "B"
TypeError: 'str' object does not
support item assignment
```

LISTS

- Lists can be concatenated using the `+` operator

```
cats = [ 'garfield', 'lola', 'scaredy']

famous_cats = [ 'whiskers', 'grumpy
                cat']

# Use the + operator to concatenate
# lists
all_cats = cats + famous_cats

print all_cats

# >>> ['garfield', 'lola', 'scaredy',
'whiskers', 'grumpy cat']
```

LISTS

- Combined concatenation and value reassignment

```
cats = [ 'garfield', 'lola', 'scaredy']
famous_cats = [ 'whiskers', 'grumpy
cat']


# Use the += operator to concatenate
# and reassign to original list
# cats = cats + famous_cats
cats += famous_cats


print cats
# >>> ['garfield', 'lola', 'scaredy',
'whiskers', 'grumpy cat']
```

LISTS

- Lists can be sliced
  - list[start:stop]

```
cats = [ 'garfield', 'lola', 'scaredy']
famous_cats = [ 'whiskers', 'grumpy
                    cat']

# Use the + operator to concatenate
# lists
all_cats = cats + famous_cats

print all_cats

# >>> ['garfield', 'lola', 'scaredy',
'whiskers', 'grumpy cat']

print all_cats[2:5]
# >>> ['scaredy', 'whiskers', 'grumpy
cat']
```

LISTS

- A list can be empty

```
drinks = []

print drinks  # []
```

LISTS

- List have built-in functions
  - append(item)

```
drinks = []
print drinks  # []

drinks.append("Soda")
print drinks # ['Soda']

drinks.append("Wine")
print drinks # ['Soda', 'Wine']

drinks.append("Beer")
print drinks # ['Soda', 'Wine', 'Beer']
```

LISTS

- List have built-in functions
  - extend(list)

```
drinks = []
print drinks  # []


drinks.append("Soda")
print drinks # ['Soda']


more_drinks = ["Wine", "Beer"]
drinks.extend(more_drinks)
print drinks # ['Soda', 'Wine', 'Beer']
```

LISTS

- List have built-in functions
  - sort()

```
print drinks # ['Soda', 'Wine', 'Beer']

drinks.sort()

print drinks # ['Beer', 'Soda', 'Wine']
```

LISTS

- List have built-in functions
  - sorted(list) vs list.sort()
- Pay attention to returned values of functions

```
list = [6,4,2,3]
print list
# >>> [6, 4, 2, 3]

# sorted() returns a new list the
# original list remains the same
print sorted(list)
# >>> [2, 3, 4, 6]

print list
# >>> [6, 4, 2, 3]

print list.sort()
# None

print list
# >>> [2, 3, 4, 6]
```

LISTS

```
drinks = []
print drinks  # []

drinks.append("Soda")
print drinks # ['Soda']

more_drinks = ["Wine", "Beer"]
drinks += more_drinks
print drinks
# ['Soda', 'Wine', 'Beer']

drinks.insert(0,'Lemonade')
print drinks
# ['Lemonade', 'Soda', 'Wine', 'Beer']
```

INSERT(INDEX,VALUE)

LISTS

```
drinks = ["Soda", "Wine", "Beer", "Lemonade"]
print drinks
# ['Soda', 'Wine', 'Beer', 'Lemonade']

del drinks[0]
print drinks
# ['Wine', 'Beer', 'Lemonade']

del drinks [0:2]
print drinks
# ['Lemonade']
```

DEL LIST[INDEX] REMOVES THE ITEM AND DOES NOT RETURN IT

LISTS

```
drinks = ["Soda", "Wine", "Beer", "Lemonade"]
del drinks[0]

print drinks
# ['Wine', 'Beer', 'Lemonade']

removed_item = drinks.pop()
print removed_item
# Lemonade

print drinks
# ['Wine', 'Beer']
```

POP RETURNS THE ELEMENT REMOVED

LISTS

```
drinks = ["Soda", "Wine", "Beer", "Lemonade"]
print drinks
# ['Lemonade', 'Soda', 'Wine', 'Beer']

drinks.remove('Wine')
drinks.remove('Beer')
print drinks
# ['Lemonade', 'Soda']
```

REMOVE(ELEMENT) REMOVES THE ELEMENT

LISTS

- dir()
  - attempt to return a list of valid attributes (properties and methods) for that object

```
>>> x = list()
>>> type(x)

<type 'list'>
>>> y = []

>>> type(y)
<type 'list'>

>>> dir(y)
['append', 'count', 'extend', 'index',
'insert', 'pop', 'remove', 'reverse',
'sort']
```

LISTS

```
>>> x = list()
>>> type(x)

<type 'list'>
>>> y = []

>>> type(y)
<type 'list'>

>>> dir(y)
['append', 'count', 'extend', 'index', 'insert', 'pop',
'remove', 'reverse', 'sort']
```

LISTS

__X__ ARE SPECIAL FUNCTIONS USED INTERNALLY BY PYTHON

```
>>> dir(x)
['__add__', '__class__', '__contains__', '__delattr__',
'__delitem__', '__delslice__', '__doc__', '__eq__',
'__format__', '__ge__', '__getattribute__', '__getitem__',
'__getslice__', '__gt__', '__hash__', '__iadd__',
'__imul__', '__init__', '__iter__', '__le__', '__len__',
'__lt__', '__mul__', '__ne__', '__new__', '__reduce__',
'__reduce_ex__', '__repr__', '__reversed__', '__rmul__',
'__setattr__', '__setitem__', '__setslice__', '__sizeof__',
'__str__', '__subclasshook__', 'append', 'count', 'extend',
'index', 'insert', 'pop', 'remove', 'reverse', 'sort']
```

LISTS

- Built-in function `dir()`
  - Attempt to return a list of valid attributes for that object

```
>>> s = 'hi'
>>> type(s)
<type 'str'>
>>> dir(s)
['capitalize', 'center', 'count',
'decode', 'encode', 'endswith',
'expandtabs', 'find', 'format',
'index', 'isalnum', 'isalpha',
'isdigit', 'islower', 'isspace',
'istitle', 'isupper', 'join', 'ljust',
'lower', 'lstrip', 'partition',
'replace', 'rfind', 'rindex', 'rjust',
'rpartition', 'rsplit', 'rstrip',
'split', 'splitlines', 'startswith',
'strip', 'swapcase', 'title',
'translate', 'upper', 'zfill']
```

LISTS

- Lists can be function arguments

```
def add_them_up(numbers):
    # Take a list of numbers, sum
    # them and return the total
    total = 0
    for number in numbers:
        total = total + number
    return total


scores = [3, 41, 12, 9, 74, 15]
print add_them_up(scores)
```

LISTS

- Functions can return a list

```
def first_and_last(numbers):
    # Return the first and last
    # item of a list
    first = numbers[0]
    last = numbers[-1]
    first_last = [first, last]
    return first_last


scores = [3, 41, 12, 9, 74, 15]
print first_and_last(scores)
# >>> [3, 15]
```

LISTS

- There are a number of functions built into Python that take lists as parameters

```
nums = [3, 41, 12, 9, 74, 15]

print len(nums)                 # 6
print max(nums)                 # 74
print min(nums)                 # 3
print sum(nums)                 # 154
print sum(nums)/len(nums)       # 25
```

TUPLES

TUPLES

- Tuples are another kind of sequence that functions like a list
- A tuple is a fixed size grouping of elements
  - Elements which are indexed starting at 0

```
# Tuple style 1
t = 'a','b','c','d'

print type(t)
# >>> <type 'tuple'>
```

```
# Tuple style 2
t = ('a','b','c','d')

print type(t)
# >>> <type 'tuple'>
```

TUPLES

- Tuples behave likes lists

```
# Tuple style 2
t = ('a','b','c','d')


# Access elements by index
print t[0]


# Slice a tuple
print t[1:3]
# >>> ('b', 'c')


# Iterate
for x in t:
    print x,
# >>> a b c d
```

TUPLES

- Tuples are comparable
- If the first item is equal, Python goes on to the next element, and so on, until it finds elements that differ

```
>>> (0, 1, 2) < (5, 1, 2)
True

>>> (0, 1, 2000000) < (0, 3, 4)
True

>>> ( 'Jones', 'Sally' ) < ('Jones',
'Sam')
True

>>> ( 'Jones', 'Sally') == ('Adams',
'Sam')
True
```

TUPLES

- Tuples are not mutable

```
t = ('a','b','c','d')
t[2] = 'Z'


Traceback
  File "workspace.py", line 9, in
<module>
    t[2] = 'Z'
TypeError: 'tuple' object does not
support item assignment
```

TUPLES

- Tuples do not share all the functions as list

```
>>> x = (3, 2, 1)

>>> x.sort()
Traceback:
AttributeError: 'tuple' object has no
attribute 'sort'

>>> x.append(5)
Traceback:
AttributeError: 'tuple' object has no
attribute 'append'

>>> x.reverse()
Traceback:
AttributeError: 'tuple' object has no
attribute 'reverse'
```

TUPLES

- Tuples do not share all the functions as list

```
>>> l = list()
>>> dir(l)
['append', 'count', 'extend', 'index',
'insert', 'pop', 'remove', 'reverse',
'sort']
```

```
>>> t = tuple()
>>> dir(t)
['count', 'index']
```

TUPLES

- Why then?
  - Simpler and more efficient in terms of memory use and performance than lists
  - Useful for “temporary variables”

```
def biggest_and_smallest():
    """
    """
    return (big,small)
```

TUPLES

- Why then?
  - Data definition
    - (x, y, z) for a coordinate
    - (long, lat) for GPS position

```
xyz = (1,2,3)

coordinates = (long, lat)
```

TUPLES

- Tuples are convenient

```
def first_and_last(numbers):
    # Return the first and last
    # item of a list
    first = numbers[0]
    last = numbers[-1]
    first_last = [first, last]
    return first_last
```

```
scores = [3, 41, 12, 9, 74, 15]
print first_and_last(scores)
# >>> [3, 15]
```

TUPLES

- Tuples are convenient

```
def first_and_last(numbers):
    first = numbers[0]
    last = numbers[-1]
    # first_last = [first, last]
    # return first_last
    return (first,last)


scores = [3, 41, 12, 9, 74, 15]
print first_and_last(scores)
# >>> (3, 15)
```

TUPLES

- Tuples have a couple of neat tricks
- We can also put a tuple on the left-hand side of an assignment statement
- We can even omit the parentheses

```
>>> (x, y) = (4, 'fred')
>>> print y
fred

>>> (a, b) = (99, 98)
>>> print a
99

>>> a, b = (99, 98)
>>> print a
99
```

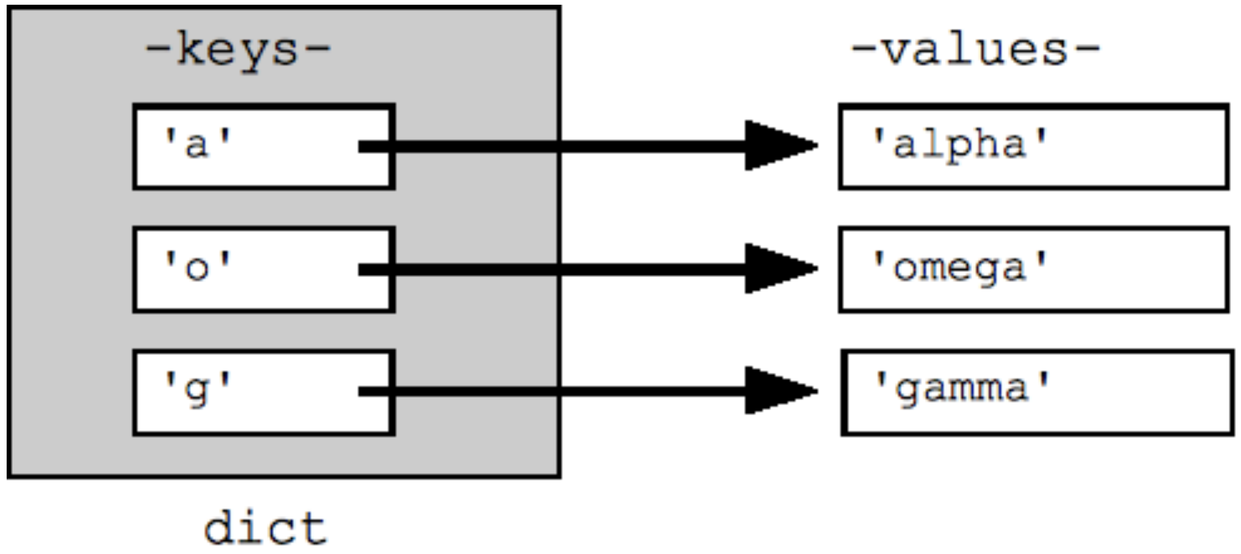
TUPLES

```
# Swap the variables a and b
>>> temp = a
>>> a = b
>>> b = temp


# Swap the variables a and b
>>> a,b = b, a
```

DICTIONARIES

DICTIONARIES

- Dictionaries are Python's most powerful data collection
  - Store values that are associated with a key (key-value pair)
  - Perform "lookup" operations
- Dictionaries have different names in different languages
  - Associative Arrays - Perl / PHP
  - Properties or Map or HashMap - Java
  - Property Bag - C# / .Net



DICTIONARIES

- Dictionaries are like lists except that they use `keys` instead of numbers to look up values

```
person = dict()
person['firstname'] = 'Bruce'
person['lastname'] = 'Wayne'
person['nickname'] = 'Batman'
person['enemies'] =['Joker','Catwoman']
person['age'] = 40

# >> {'lastname': 'Wayne', 'age': 40,
'nickname': 'Batman', 'firstname':
'Bruce', 'enemies': ['Joker',
'Catwoman']}
```

DICTIONARIES

```
person['firstname'] = 'Bruce'
person['lastname'] = 'Wayne'


# Lookup the value using the string key
print person['firstname'] # Bruce
print person['lastname']  # Wayne
```

DICTIONARIES

- Dictionary literals use curly braces and have a list of 'key : value' pairs
- You can make an empty dictionary using empty curly braces

```
hero = { 'firstname': 'Clark',
         'lastname': 'Kent',
         'age': 30 }

print hero
# >>> {'lastname': 'Kent', 'age': 30,
'firstname': 'Clark'}


# Create an empty dictionary
empty_hero = {}
# >>> {}
```

DICTIONARIES

```
vehicles = { 'bus' : 1 , 'car' : 42, 'van': 10, 'rv': 2}
print vehicles['motorcycle']
```

```
Traceback (most recent call last):
  File "workspace.py", line 20, in <module>
    print vehicles['motorcycle']
KeyError: 'motorcycle'
cles['motorcycle']
KeyError: 'motorcycle'
```

DICTIONARIES

```
vehicles = { 'bus' : 1 , 'car' : 42, 'van': 10, 'rv': 2}
```

```
# Test if a key is in a dictionary with `in`
if 'motorcycle' in vehicles:
    print "Motorcycle"
else:
   print "No motorcycle"
```

DICTIONARIES

- Pattern of checking if key exists and then looking it up
- Built-in function `get()` provides this

```
# Retrieve the count of motorcycles
# from the dictionary
count = 0
if 'motorcyle' in vehicles:
    count = vehicles['motorcyle']
else:
    count = 0
```

```
# Use `get` to test and return default
# value
count = vehicles.get('motorcycle',0)
```

DICTIONARIES

- Delete key-value pairs using `del`

```
# del with variables
var = 6
del var # var no more!


# del in lists
list = ['a', 'b', 'c', 'd']
del list[0]   ## Delete first element
del list[-2:] ## Delete last two
print list ## ['b']


# del in dictionaries
dict = {'a':1, 'b':2, 'c':3}
del dict['b']
print dict
## >>> {'a':1, 'c':3}
```

DICTIONARIES

- Dictionaries are unordered

```
hero = { 'firstname': 'Clark',
         'lastname': 'Kent',
         'age': 30 }


print hero
# >>> {'lastname': 'Kent',
       'age': 30,
       'firstname': 'Clark'}
```

DICTIONARIES

- Loop through all the entries in a dictionary
- Goes through all of the keys in the dictionary and looks up the values

```
vehicles = { 'bus' : 1 , 'car' : 42,
             'van': 10, 'rv': 2}

# The iteration variable is lookup key
for vehicle in vehicles:
    print vehicle,
# >>> bus, rv, van, car


for vehicle in vehicles:
    print vehicle, vehicles[vehicle]

# >>> bus 1
# >>> rv 2
# >>> van 10
# >>> car 42
```

DICTIONARIES

- Different ways to access keys/ values in a dictionary

```
print list(vehicles)
# ['bus', 'rv', 'van', 'car']

print vehicles.keys()
# ['bus', 'rv', 'van', 'car']

print vehicles.values()
#[1, 2, 10, 42]

print vehicles.items()
# [('bus', 1), ('rv', 2), ('van', 10),
('car', 42)]
```

DICTIONARIES

- .items() returns a tuple as the iteration variable
- Shortcut to assign them directly to a pair of iteration variables

```
# Using .items() returns a tuple
print vehicles.items()

# >>> [('bus', 1), ('rv', 2), ('van',
10), ('car', 42)]
```

```
for key,value in vehicles.items():
    print key,"->",value
# bus -> 1
# rv -> 2
# van -> 10
# car -> 42
```

FILES AND PARSING

FILES AND PARSING

- Applications need to persist data between sessions
- Reading and writing data to disk

```
<Books>
    <Book ISBN="0553212419">
        <title>Sherlock Holmes: Complete Novels...
        <author>Sir Arthur Conan Doyle</author>
    </Book>
    <Book ISBN="0743273567">
        <title>The Great Gatsby</title>
        <author>F. Scott Fitzgerald</author>
    </Book>
    <Book ISBN="0684826976">
        <title>Undaunted Courage</title>
        <author>Stephen E. Ambrose</author>
    </Book>
    <Book ISBN="0743203178">
        <title>Nothing Like It In the World</title
        <author>Stephen E. Ambrose</author>
    </Book>
</Books>
```

FILES AND PARSING

- Files contain different types of data
  - Structured format (csv, XML, JSON, HTML)
  - Text (.txt)
  - Binary (.docx, .sql)
- An application can use any of these file types to save data

```
<Books>
    <Book ISBN="0553212419">
        <title>Sherlock Holmes: Complete Novels...
        <author>Sir Arthur Conan Doyle</author>
    </Book>
    <Book ISBN="0743273567">
        <title>The Great Gatsby</title>
        <author>F. Scott Fitzgerald</author>
    </Book>
    <Book ISBN="0684826976">
        <title>Undaunted Courage</title>
        <author>Stephen E. Ambrose</author>
    </Book>
    <Book ISBN="0743203178">
        <title>Nothing Like It In the World</title
        <author>Stephen E. Ambrose</author>
    </Book>
</Books>
```

FILES AND PARSING

- Different formats have different properties
  - Size
  - Privacy
  - Human readable

JSON

```
{
"siblings": [
{"firstName":"Anna","lastName":"Clayton"},
{"lastName":"Alex","lastName":"Clayton"}
]
}
```

XML

```
<siblings>
<sibling>
<firstName>Anna</firstName>
<lastName>Clayton</lastName>
</sibling>
<sibling>
<firstName>Alex</firstName>
<lastName>Clayton</lastName>
</sibling>
</siblings>
```

FILES AND PARSING

- Python has built-in functions to help read text-based files
- Reading some file types may require special libraries
  - Write your own

```
# Open the file
f = open('./speech.txt', 'r')

## Iterate over lines of the
file
for line in f:
  print line,
f.close()
```

FILES AND PARSING

- Tell Python which file we are going to work with and what we will be doing with the file
- This is done with the open() function
- Returns a “file handle”
  - A variable used to perform operations on the file

```
# Open the file
# file handle is `f`
f = open('./speech.txt', 'r')


## Iterate over lines of the
file
for line in f:
  print line,
f.close()
```

FILES AND PARSING

- handle = open(filename, mode)
  - Returns a file handle
  - Filename is a string
  - Mode is optional
    - 'r' if we are planning to read the file
    - 'w' if we are going to write to the file

```
# Open the file for reading
f = open('./speech.txt', 'r')
```

```
# Write to a file
f = open('./speech.txt', 'w')
```

FILES AND PARSING

- Good place to use try/except

```
# You need to check if a files is
# present before opening it
f = open('./missing.txt', 'r')
```

```
Traceback (most recent call last):
  File "workspace.py", line 2, in
<module>
    f = open('./speedch.txt', 'r')
IOError: [Errno 2] No such file or
directory: './missing.txt'
```

FILES AND PARSING

- A file handle open for read can be treated as a sequence of strings
- Each line in the file is a string in the sequence

```
f = open('./names.txt', 'r')

# iterates over the lines of the file
# handle
for line in f:
    print line
f.close()
```

FILES AND PARSING

- Files have special (invisible) characters used in formatting
  - `\n` - "newline" to indicate when a line ends
  - `\t` - tab

```
>>> stuff = 'Hello\nWorld!'
>>> stuff
'Hello\nWorld!'

>>> print stuff
Hello
World!


>>> stuff = 'X\nY'
>>> print stuff
X
Y
>>> len(stuff)
3
```

FILES AND PARSING

- Pay attention to newline characters when printing
- You are reading them in from the file

```
f = open('./names.txt', 'r')
for line in f:
    print line
f.close()


# Charles
#
# Lucy
#
# Snoopy
```

FILES AND PARSING

- We can read the whole file into a single string
  - \n are read in as well

```
# Read the entire file into
# a variable
f = open('./names.txt', 'r')

entire_file = f.read()


print len(entire_file)
# >> 54
```

FILES AND PARSING

- Clean up your data using string functions
- 'Whitespace' means characters you can not see
  - \t,\n,\ ,etc.

```
>>> s = "s"
>>> dir(s)
['capitalize', 'center', 'count',
'decode', 'encode', 'endswith',
'expandtabs', 'find', 'format',
'index', 'isalnum', 'isalpha',
'isdigit', 'islower', 'isspace',
'istitle', 'isupper', 'join', 'ljust',
'lower', 'lstrip', 'partition',
'replace', 'rfind', 'rindex', 'rjust',
'rpartition', 'rsplit', 'rstrip',
'split', 'splitlines', 'startswith',
'strip', 'swapcase', 'title',
'translate', 'upper', 'zfill']
```

FILES AND PARSING

```
# Echo the contents of a file
f = open('./names.txt', 'r')

for line in f:

    # Remove whitespace
    clean_line = line.strip()

    # Make case uniform
    clean_line = clean_line.lower()
    print clean_line

f.close()
```

FILES AND PARSING

```
# Split() splits a string into a list at a " "
>>> y = 'the quick brown fox jumped over the yellow dog'
>>> z = y.split()
>>> z
['the', 'quick', 'brown', 'fox', 'jumped', 'over', 'the',
'yellow', 'dog']


# Split(',') splits a string on a comma
>>> y = "1,2,3,4,5,6,7,8,9"
>>> z = y.split(',')
>>> z
['1', '2', '3', '4', '5', '6', '7', '8', '9']
```

FILES AND PARSING

- Cleaning up data is a fundamental problem in computer science
- There are many tools and workflows to accomplish a task
  - Sometimes it is easier to clean up your data before inputing it into a program
  - Sometimes you will write two programs (one to clean, one to process)

FILES AND PARSING

- We will revisit reading/writing files later in the course

THE END

MPCS 50101
WINTER 2018
SESSION 3

THE UNIVERSITY OF CHICAGO

BREAK TIME

ASSIGNMENT

ASSIGNMENT

- http://uchicago.codes/sessions/session5/
- Reading

MPCS 50101

concepts of programming

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Forum

Assignment

Assignment 2 is due Wednesday, January 18th, 2017 at 5:29pm. For each problem, create a file name problem1.py, problem2.py, etc. Please make judicious use of comments in your code. Use GitHub classroom to submit your work. We will only grade `master` branch.

- Task 1. Submit your assignment 1 using GitHub classroom.
- Problem 1. Create a temperature converter program that takes input in Fahrenheit and converts to Celsius. You should check that the input is valid.
- Problem 2. Write a program to prompt for a score between 0 and 100. If the score is out of range, print an error message. If the score is between 0 and 100, print a grade using the following table:
  - A >= 90
  - B >= 80

GIT BRANCH AND MERGE