CPS 109 - Review 2022

Agenda

1. Reading/Deciphering Questions
2. help()
3. Lists
4. Dictionaries
5. Recursion
6. Classes/OOP
7. Testing

Exam Details

1. Date: December 15th 2022 (a bit over 2 weeks from now)
2. Time: Varies per section (9 am / noon / 3 pm)
3. Location: Depends on section. Should be on your personalized exam schedule (ENG)
4. Format similar to midterm. D2L on the lab computers. Closed book. More short answer questions than code download / unittest questions. More details later. Ask your profs.

Exam Advice

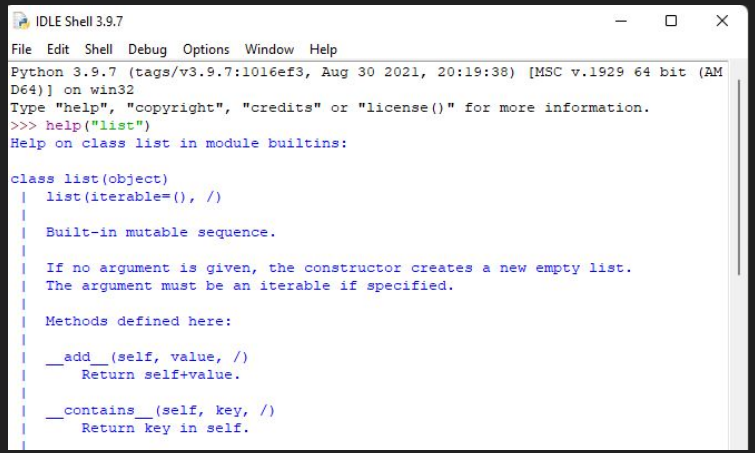
1. Study hard. The exam is worth **up to 70%** (45% + 25% from midterm if better)
2. Good ways to study include:
   a. Reading over the lecture slides
   b. Practicing problems (e.g. extras from A2 set)
   c. Doing questions under artificial time constraints
3. When the exam comes around - don’t stress. There’s nothing you can do to change the past at that point; do your best given your preparation

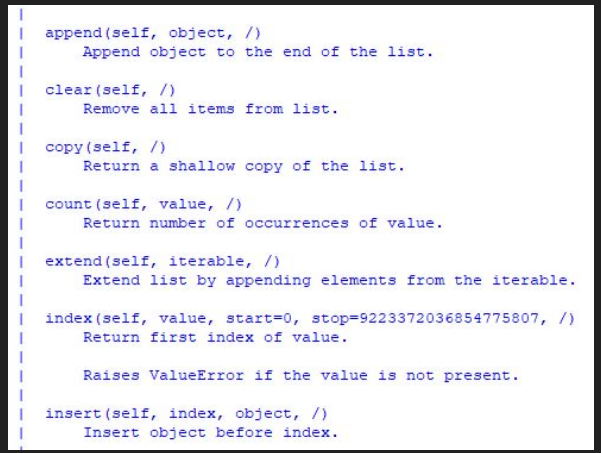
Using Python's "help()"

- Confirm this with your professors, but I believe you can use Python's help() function similar to the midterm
- Two primary things it can help with

More “help()”

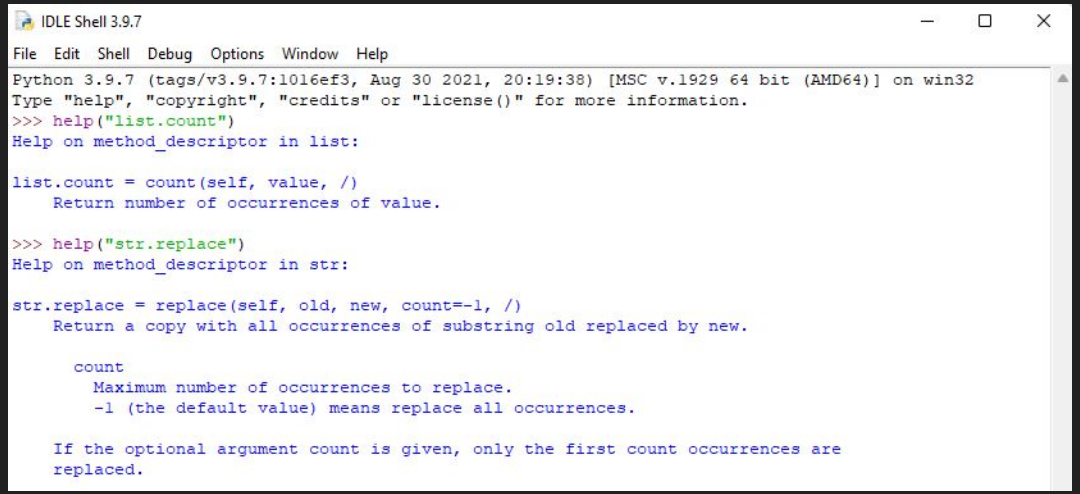
- “What are the available methods for a data type?”





Even More “help()”

- “How can I use a specific method?”



Interpreting “help()”

```
>>> help("list.count")
Help on method_descriptor in list:

list.count = count(self, value, /)
    Return number of occurrences of value.
```

```
>>> my_list = ["bear", "dog", "bear", "cat"]
>>> print(my_list.count("bear"))
2
>>> print(my_list.count("dog"))
1
```

```
>>> help("str.replace")
Help on method_descriptor in str:

str.replace = replace(self, old, new, count=-1, /)
    Return a copy with all occurrences of substring old replaced by new.

      count
        Maximum number of occurrences to replace.
        -1 (the default value) means replace all occurrences.

    If the optional argument count is given, only the first count occurrences are
    replaced.
```

```
>>> my_string = "i love-hate python!"
>>> print(my_string.replace("love", "hate"))
i hate-hate python!
>>> print(my_string)
i love-hate python!
>>> my_string = my_string.replace("hate", "love")
>>> print(my_string)
i love-love python!
>>> print("wheeeeeze".replace("e", "", 3))
wheeze
```

Understanding Questions

It came to my attention that everyone is having a bit of trouble understanding what a problem or question is looking for.

Understanding Questions

```
import unittest
'''
Assume that s is a string. Check to see if s is a palindrome.
If it is, return True. Else, return False. Recall that a
palindrome is a string that is the same string if reversed.

You must use RECURSION to solve the problem.

For example,
recursive_palindrome('racecar') is True
recursive_palindrome('blue') is False

Three test cases have been included. Add two more,
both of which should be edge cases.
'''
def recursive_palindrome(s) :
    pass
```

1. What is the problem asking of me?
2. What are the input(s) to my function?
3. What are the output(s) of my function?
4. Are there any special instructions?
5. What do the unittests tell me?

Understanding Questions

```
19  class PalinTests(unittest.TestCase):
20      def test1(self):
21          self.assertTrue(recursive_palindrome('racecar'))
22      def test2(self):
23          self.assertFalse(recursive_palindrome('blue'))
24      def test3(self):
25          self.assertTrue(recursive_palindrome('madam'))
26
27  if __name__=='__main__':
28      unittest.main(exit=True)
```

- Unittests (if provided) can help guide you to a correct solution
- With Short Answer questions it can be a bit more tricky, as it is easier to let a logic error or a question misinterpretation slip through
- Read the questions VERY carefully

A Note On Mutability

Something is **mutable** if its contents can be changed (like a list).

Something is **immutable** if its contents cannot be changed (like a string or a tuple) and instead you have to overwrite it.

List Syntax Review

```python
# Brief Crash Course for Lists

my_list = []
my_predefined_list = [1, '2', 3, '4']

my_list.append(1) # [1]
#print(my_list)
my_list += ['2', 3] # [1, '2', 3]
#print(my_list)
my_list.extend(['4']) # [1, '2', 3, '4']
#print(my_list)

print(my_list == my_predefined_list) # True
print(my_list is my_predefined_list) # False

my_list_copy = my_list[:] # To make a copy

print(my_list.count(1)) # 1
print(my_list.index('4')) # 3

for i in my_list: # Iterating via element
    print(i, end='')
print()

for i in range(len(my_list)): # Iterating via index
    print(my_list[i], end='')
print()

print(my_list[0]) # 1st element: 1
print(my_list[-1]) # Last element: '4'
print(my_list[0:2]) # Slicing: [1, '2']
```

```
True
False
1
3
1234
1234
1
4
[1, '2']
[Finished in 50ms]
```

Dictionary Syntax 1

```python
# Brief Crash Course for Dictionaries

my_dict = {}
my_thesaurus = {"great":["fantastic", "awesome"], "bad":["substandard", "poor", "inferior"], "medium":["average"]}

my_dict["great"] = ["fantastic", "awesome"]
#print(my_dict["bad"]) # Would cause an error!

my_dict["bad"] = ["substandard", "poor"]
my_dict["bad"] += ["inferior"]

my_dict["medium"] = ["average"]

print(my_dict == my_thesaurus) # True

if ("medium" in my_dict): # Yes
    print("Yes")

if ("brad" in my_dict): # No
    print("Nice try brad")

for key in my_dict.keys():
    print(key)
    print(my_dict[key])

for value in my_dict.values():
    print(value) # No way to get associated key

for k, v in my_dict.items():
    print(k, v)
```

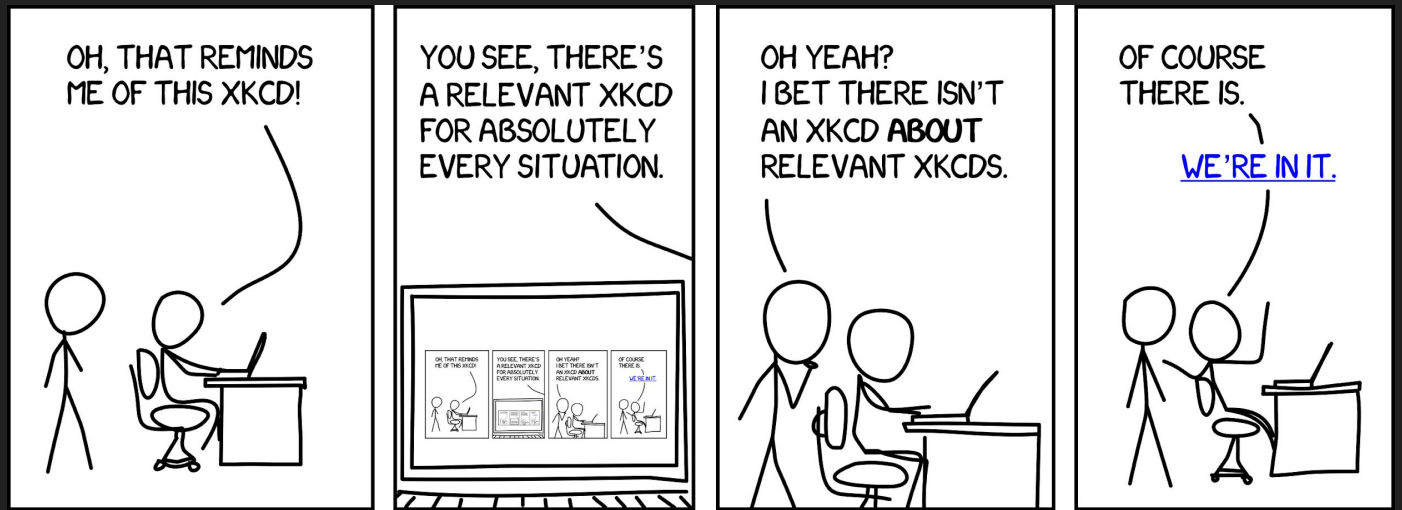
```
True
Yes
great
['fantastic', 'awesome']
bad
['substandard', 'poor', 'inferior']
medium
['average']
['fantastic', 'awesome']
['substandard', 'poor', 'inferior']
['average']
great ['fantastic', 'awesome']
bad ['substandard', 'poor', 'inferior']
medium ['average']
[Finished in 51ms]
```

Random/2D Array/Exception Handling Syntax

Check out the crash course on the Github for more examples re: these concepts, in addition to your professor's lecture slides!
Link: https://github.com/ChrisKolios/CPS109_Fall2022/blob/master/Lab9/Lab9CrashCourse.py

Recursion

Recursion is a special sort of “loop”, so to speak. It refers to a type of function that can call itself in its execution.



Recursion

How do you design a recursive function? Here are my suggested steps:

1. Make sure your function has a clear goal
2. Write out (then type up) your 1 or more base cases.
3. Design your recursive step.

Object Oriented Programming

Also known as OOP(there it is).

The long as short of OOP is really quite simple: every single piece of data is an object. But what on Earth is an object??

Object Oriented Programming

For all intents and purposes, there are two main kinds of objects you all need to be aware of:

1) Native objects (the datatypes you all love and know)
2) Classes you've defined yourselves

Classes

Recall that classes are custom data types that you can make yourself! They can contain any and all member variables so long as you declare the class properly.

They also contain any and all member/instance methods (internal functions).

Classes

```
class Rectangle(object) :
    '''This class represents a rectangle in the x-y coordincate system
    where the edges of the rectangle are aligned with the x- and y- axes.
    A Rectangle object has data attributes lowerleft and upperright,
    which are tuples representing the (x, y) coordinates of the lower
    left corner and the upper right corner.
    '''
    def __init__(self, x1, y1, x2, y2) :
        '''Assumes the (x1, y1) are the coordinates of the lower left corner
        and (x2, y2) are the coordinates of the upper right corner.
        '''
        self.lowerleft = (x1, y1)
        self.upperright = (x2, y2)
```

Classes Problem Walkthrough

```
'''
Story: The Teletubbies are vanquished, but in the realm of dreams they still haunt
you! Your task is to implement the following classes and helper methods according
to the requirements described in each class/method, so as to conquer your nightmares,
and obliterate all traces of the Teletubbies!
'''

class Dream:
    '''
    Dreams are pretty good. Usually with apple pies and candies and all that good stuff.

    Your task is as follows:
    Construct the "__init__" method for a Dream class, that takes in 2 arguments (plus self),
    self (which you ALWAYS require in your constructors, even if there is nothing else in them!)
    a string "title", and
    an int "length"
    And sets a list dream_elements to start as the empty list: []
    [1]

    Then, once you have completed your constructor, create an instance method called
    change_title(a), which changes the title of your dream instance to the string a.
    [2, 3]

    Then, create another instance method called add_to_dream(topic), which adds the string
    topic to the dream_elements list.
    [2, 3]

    Finally, create an instance method dreams_to_dust(), which replaces each element of the
    dream_elements list with the string "dust".
    [2, 3]
    '''
    pass
```

How to decompose a “Class” exam problem

1: Identify what variables your class has
2: Implement the “__init__” method
3: Identify what instance methods you will need to implement (pay special attention to the input arguments and expected return values)
4: Implement the instance methods

Constructor Criticism

```python
class Dream:
    '''
    Dreams are pretty good. Usually with apple pies and candies and all that good stuff.

    Your task is as follows:
    Construct the "__init__" method for a Dream class, that takes in 2 arguments (plus self),
    self (which you ALWAYS require in your constructors, even if there is nothing else in them!)
    a string "title", and
    an int "length"
    And sets a list dream_elements to start as the empty list: []
    '''
    def __init__(self, title, length):
        self.title = title
        self.length = length
        self.dream_elements = []
```

```python
d = Dream("Dream Where I Pass My Exam", 4)
```

```python
class Nightmare:
    '''
    Nightmares are pretty bad. Usually with Teletubbies and chainsaws and all that bad stuff.

    Your task is as follows:
    Construct the "__init__" method for a Nightmare class, that takes in 0 arguments (except self of course)!
    However, you should create an instance variable "topic" that defaults to the string
    "Teletubbies", and an instance variable for an attached Dream that the nightmare is
    in, called "attached_dream" (which defaults to None).
    [1]
    '''
    def __init__(self):
        self.topic = "Teletubbies"
        self.attached_dream = None
```

```python
n = Nightmare()
```

How to make the __init__:

1: Write out the first line, including self and any other input arguments
2: Set self.internal_variables to input arguments
3: Create any default internal variables
4: (Optional) Perform any required behaviour

How to handle empty constructors:

1: Make sure you include self in the brackets
2: Everything else should be in the __init__ body

Unittests as a Guide

```
27  class Dream:
28      '''
29      Dreams are pretty good. Usually with apple pies and candies and all that good stuff.
30
31      Your task is as follows:
32      Construct the "__init__" method for a Dream class, that takes in 2 arguments (plus self),
33      self (which you ALWAYS require in your constructors, even if there is nothing else in them!)
34      a string "title", and
35      an int "length"
36      And sets a list dream_elements to start as the empty list: []
37      '''
38      def __init__(self, title, length):
39          self.title = title
40          self.length = length
41          self.dream_elements = []
```

```
d = Dream("Dream Where I Pass My Exam", 4)
```

```
66  class Nightmare:
67      '''
68      Nightmares are pretty bad. Usually with Teletubbies and chainsaws and all that bad stuff.
69
70      Your task is as follows:
71      Construct the "__init__" method for a Nightmare class, that takes in 0 arguments (except self of course)!
72      However, you should create an instance variable "topic" that defaults to the string
73      "Teletubbies", and an instance variable for an attached Dream that the nightmare is
74      in, called "attached_dream" (which defaults to None).
75      [1]
76      '''
77      def __init__(self):
78          self.topic = "Teletubbies"
79          self.attached_dream = None
```

```
n = Nightmare()
```

```
141 class myTests(unittest.TestCase):
142     def test1(self): # Testing Dream constructor
143         d = Dream("my awesome dream", 5)
144         self.assertEqual(d.title, "my awesome dream")
145         self.assertEqual(d.length, 5)
146         self.assertEqual(d.dream_elements, [])
147     def test2(self): # Testing nightmare constructor
148         n = Nightmare()
149         self.assertEqual(n.topic, "Teletubbies")
150         self.assertEqual(n.attached_dream, None)
```

Function Flattery

```
    Then, once you have completed your constructor, create an instance method called
    change_title(a), which changes the title of your dream instance to the string a.
    [2, 3]

    Then, create another instance method called add_to_dream(topic), which adds the string
    topic to the dream_elements list.
    [2, 3]

    Finally, create an instance method dreams_to_dust(), which replaces each element of the
    dream_elements list with the string "dust".
    [2, 3]
    '''
    def change_title(self, a):
        self.title = a

    def add_to_dream(self, topic):
        self.dream_elements.append(topic)

    def dreams_to_dust(self):
        for element in range(len(self.dream_elements)):
            self.dream_elements[element] = "dust"
```

```
    def test3(self): # Testing Dream.change_title()
        d = Dream("my awesome dream", 5)
        d.change_title("my great dream")
        self.assertEqual(d.title, "my great dream")
    def test4(self): # Testing Dream.add_to_dream()
        d = Dream("my awesome dream", 5)
        d.change_title("my great dream")
        d.add_to_dream("rainbows")
        d.add_to_dream("butterflies")
        self.assertEqual(d.dream_elements, ["rainbows", "butterflies"])
```

How to create an instance function:

1: The first argument should always be self

2: Whenever you want to access a variable from the instance of a class, use the syntax: self.variable. To modify, use: self.variable = new_value

3: Treat it like any other function! If you need to return, then return. If you need to perform some logic, then do so! Don't get scared!

Unittests are always helpful!

Funception

```
    Then, create a method attach_to_dream(d), which attached your nightmare instance
    to a dream via setting attached_dream to the argument Dream d.
    [2, 3]

    Then, create a method has_attached_dream() which returns True if your attached_dream
    is not None, and False otherwise.
    [2, 3]

    Finally, create a method WAKE_ME_UP(), which will set the attached_dream's length to 0,
    and call it's dreams_to_dust() method.
    [2, 3]
    '''
    def attach_to_dream(self, d):
        self.attached_dream = d

    def has_attached_dream(self):
        if (self.attached_dream is not None):
            return True
        else:
            return False

    def WAKE_ME_UP(self):
        if (self.has_attached_dream()):
            self.attached_dream.length = 0
            self.attached_dream.dreams_to_dust()
```

Just like any other function, there is no limit to how many times you can call an instance function, its contents, and where you can call it.

You'll notice that in the WAKE_ME_UP() function, it takes the Dream object associated with the nightmare (if it exists (which it checks via calling self.has_attached_dream()!)) and calls that Dream object's dreams_to_dust() instance function! This is totally legit yo!

‘Helper’ Me Out!

```
107 def return_titles(list_of_dreams):
108     '''
109     Create a method that takes in a list of Dreams "list_of_dreams" as input, and returns
110     a list containing the titles of all Dreams in that list.
111     [2, 4]
112     '''
113     to_return_list = []
114     for dream in list_of_dreams:
115         to_return_list.append(dream.title)
116     return to_return_list
117 
118 def WAKE_ME_UP_INSIDE(cant_wake_up):
119     '''
120     Create a method that takes in a list of Nightmares "cant_wake_up", as input, which
121     then calls the WAKE_ME_UP() method for each Nightmare in the list.
122     [3, 4]
123     '''
124     for nightmare in cant_wake_up:
125         nightmare.WAKE_ME_UP()
126 
127 def how_long_are_my_dreams(list_of_dreams):
128     '''
129     Create a method that takes in a list of Dreams "list of dreams" as input, and returns
130     the sum of all Dream lengths in that list.
131     [2, 4]
132     '''
133     total_sum = 0
134     for dream in list_of_dreams:
135         total_sum += dream.length
136     return total_sum
```

Helper functions are just normal functions that are built to interact with Classes in some manner.

Notice that we can access a class object c’s internal variable x via the syntax:
c.x
We can even modify c.x, via the syntax:
c.x = new_val

You can also call instance methods outside of a class (**where self is implicitly being assigned to the instance of the class object!**)

[illegible]() looks like:

```
102     def WAKE_ME_UP(self):
```

but self is not provided, just being implicitly assigned to nightmare. Check out the unittests for hints!

A Note for the Class

While classes are just a portion of your exam, the reason why we went into so much detail is because the general framework for such a question is applicable to ANY programming question you have on your exam.

You should always:

1. Read what the question is asking for carefully
2. Be especially careful about the inputs arguments / desired returns (types, names, etc.)
3. Use the unittests as a fallback guide when something is not super clear

Inheritance

But why use classes? I don’t even care about predefined behaviour.

Well that’s where you’re wrong, bucko. One of most powerful features of classes and OOP is that of inheritance.

Inheritance

```
class Cat(Animal):
    '''
    Child class of Animal called Cat. Since cats aren't
    brushed by default, the member variable for is_brushed is
    set to False.
    '''
    def __init__(self, name, age, fur_colour, eye_colour):
        super().__init__(name, age)
        self.fur_colour = fur_colour
        self.eye_colour = eye_colour
        self.is_brushed = False
```

Testing

Testing is insanely important yet no one really presses in why it’s important. Now, we are gonna contextualize the testing syntax you’ve seen AND make you good at writing tests.

Testing

In this course, particularly in the midterm, you've seen the predictable syntax. You declare a test class with member methods and then call it in your __main__ (remember that if your code isn't in a function or class, it goes in the main!)

This is where it all comes together...

Testing

```
class myTests(unittest.TestCase):
    def test0(self):
        self.assertEqual(outside_of(5, 6, 2), False)
    def test1(self):
        self.assertEqual(outside_of(5, 7, 1.5), True)
    def test2(self):
        self.assertEqual(outside_of(1, 2, 1), False)
    def test3(self):
        self.assertEqual(outside_of(9, 9, 0), False)
    def test4(self):
        self.assertEqual(outside_of(9, 9, 100), False)
    def test5(self):
        self.assertEqual(outside_of(-90, 100, 0), True)
```

Thanks for Listening!

- If you have any questions / comments / concerns, please reach out at: ckolios@ryerson.ca
- Don’t forget to submit your A2!
- Good luck with your exams. Study hard!