LINKED LISTS

COMPUTER SCIENCE MENTORS 61A

February 29 to March 5, 2016

1. **(H)OOP**
   Given the following code, what will Python output for the following prompts?

```
class Baller:
        all_players = []
        def __init__(self, name, has_ball = False):
                self.name = name
                self.has_ball = has_ball
                Baller.all_players.append(self)

        def pass_ball(self, other_player):
                if self.has_ball:
                self.has_ball = False
                other_player.has_ball = True
                return True
        else:
                return False

class BallHog(Baller):
        def pass_ball(self, other_player):
                return False
>>> tiffany = Baller('Tiffany', True)
>>> garrett = BallHog('Garrett')
>>> len(Baller.all_players)
```

Solution: 2

```
>>> Baller.name
```

Solution: Error

```
>>> len(garrett.all_players)
```

Solution: 2

```
>>> tiffany.pass_ball()
```

Solution: Error

```
>>> tiffany.pass_ball(garrett)
```

Solution: True

```
>>> tiffany.pass_ball(garrett)
```

Solution: False

```
>>> BallHog.pass_ball(garrett, tiffany)
```

Solution: False

```
>>> garrett.pass_ball(tiffany)
```

Solution: False

```
>>> garrett.pass_ball(garrett, tiffany)
```

Solution: Error

2. **TeamBaller**
   Write `TeamBaller`, a subclass of `Baller`. An instance of `TeamBaller` cheers on the team every time it passes a ball.
   Hint: What can we use to avoid writing duplicate code?
   "Super" Hint: There are two ways to implement `pass_ball`

```
>>> cheerballer = TeamBaller('Susanna', has_ball=True)
>>> cheerballer.pass_ball(garrett)
Yay!!!!
True
>>> cheerballer.pass_ball(garrett)
I dont have the ball :(
False
```

```
class TeamBaller(__________):
        def pass_ball(__________, ___________):
```

Solution:

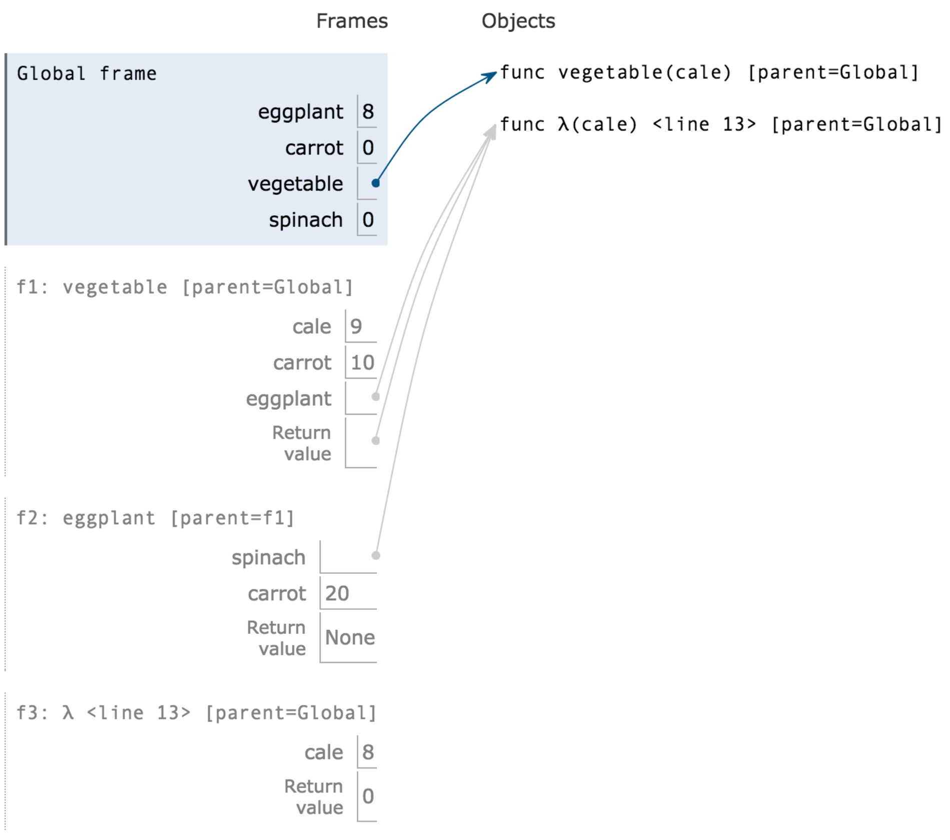
```
class TeamBaller(Baller):
        def pass_ball(self, other_player):
                did_pass = super().pass_ball(other_player)
                # above line could also be:
                # did_pass = Baller.pass_ball(self,
                   other_player)
                if did_pass:
                        print('Yay!!!!')
                else:
                        print("I dont have the ball :(")
```

3. **Nonlocal Kale**

Draw the environment diagram for the following code.

```
eggplant = 8
carrot = 0
def vegetable(kale):
    carrot = 10
    def eggplant(spinach):
        nonlocal eggplant
        nonlocal kale
        kale = 9
        carrot = 20
        eggplant = spinach
    eggplant(kale)
    return eggplant
spinach = vegetable(lambda kale: carrot*kale)(eggplant)
```

Solution:



4. **Pinpong again...**

   Recap of ping-pong: The ping-pong sequence counts up starting from 1 and is always either counting up or counting down. At element k, the direction switches if k is a multiple of 7 or contains the digit 7. The first 30 elements of the ping-pong sequence are listed below, with direction swaps marked using brackets at the 7th, 14th, 17th, 21st, 27th, and 28th elements:

   ```
   1 2 3 4 5 6 [7] 6 5 4 3 2 1 [0] 1 2 [3] 2 1 0 [-1] 0 1 2 3 4
      [5] [4] 5 6
   ```

   Implement a function `make_pingpong_tracker` that returns the next value in the pingpong sequence each time it is called. In the body of `make_pingpong_tracker`, you can use assignment statements.

   ```python
   def has_seven(k): #Use this function for your answer below
       if k % 10 == 7:
           return True
       elif k < 10:
           return False
       else:
           return has_seven(k // 10)
   ```

```
def make_pingpong_tracker():
""" Returns a function that returns the next value in the
  pingpong sequence each time it is called.
        >>> output = []
        >>> x = make_pingpong_tracker()
        >>> for _ in range(9):
        ...     output += x()
        >>> output
        [1, 2, 3, 4, 5, 6, 7, 6, 5]
        """
        index, current, add = 1, 0, True
        def pingpong_tracker():
                __________________________
        if add:
                ________________________
        else:
                ________________________
        if ________________________:
                add = not add
        __________________________
        __________________________
return pingpong_tracker
```

Solution:

```
def make_pingpong_tracker():
        index, current, add = 1, 0, True
        def pingpong_tracker():
                nonlocal index, current, add
                if add:
                        current = current + 1
                else:
                        current = current - 1
                if has_seven(index) or index % 7 == 0:
                        add = not add
                index += 1
                return current
        return pingpong_tracker
```

5. **(Optional)** Instead of using nonlocal for pingpong, let's use OOP!

```
>>> tracker1 = PingPongTracker()
>>> tracker2 = PingPongTracker()
>>> tracker1.next()
1
>>> tracker1.next()
2
>>> tracker2.next()
1

Bonus points if you can get the following syntax.
>>> tracker1()
1
>>> tracker1()
2

class PingPongTracker:
    def __init__(self):
        self.current = 0
        self.index = 0
        self.add = True
    def next(self):
        *** Enter solution below ***
```

Solution:

```
class PingPongTracker:
        def __init__(self):
                self.current = 0
                self.index = 0
                self.add = True

        def next(self):
                if self.add:
                        self.current += 1
                else:
                        self.current -= 1
                if has_seven(self.index) or self.index%7 ==
                    0:
        self.add = not self.add
self.index += 1
return self.current
```

Notice how the OOP approach is insanely similar to the non local function. Instead of using nonlocal, we use self.varName and the code becomes exactly the same. We just store the data in a slightly different way. This implies that OOP and functions are pretty similar, and it turns out you can even write your own OOP framework using just functions and nonlocal!

In addition, there are a lot of python specific features that can be written using functions or using classes. If you are interested, check out the powerful python feature decorators, and note how we can write them both as functions and as classes!