Worksheet: Using recursion
COSC 101, 2018-04-11

1) Warm-up
Assume you have been provided the following function (which we wrote in class on Monday):

```python
def downupN(string, n):
    if n == 1:
        print(string)
    else:
        print(string[:n])
        downupN(string, n-1)
        print(string[:n])
```

a) List the sequence of statements that are executed when the following lines of code are executed:

```python
word = "cosc"
downupN(word, len(word))
```

b) Modify the `downupN` function to eliminate the parameter `n` and instead use the `len` function.
Visualizing recursion example: drawing trees

t = turtle.Turtle()
def treeN(n):
    if n == 0:
        t.stamp()
    else:
        t.forward(n*15) # Branch
        t.right(20)
        treeN(n-1,t) # Right fork
        t.left(40)
        treeN(n-1,t) # Left fork
        t.right(20)
        t.backward(n*15) # Back down branch

2) Visualizing recursion

List the recursive calls for each of the following programs. Also, what does each program output?

a) def string_mystery(s):
    if len(s) <= 1:
        return s
    else:
        one = s[0] * len(s)
        rest = string_mystery(s[1:])
        return one + rest

print(string_mystery("ABCD"))

b) def half_mystery(lst):
    if len(lst) == 1:
        return lst[0]
    else:
        mid = len(lst)//2
        left_half = half_mystery(lst[:mid])
        right_half = half_mystery(lst[mid:]
        if left_half < right_half:
            return left_half
        else:
            return right_half

print(half_mystery([5,2,4,3]))
3) Recursion rules: base case
For each of the following problems, what is the condition and result for the base case?
   a) Count the number of people between you and the left wall of the classroom, including yourself

   b) downup

   c) Draw a tree

   d) Sum the numbers in a list

   e) Reverse the characters in a string --- e.g., "COLGATE" becomes "ETAGLOC"

4) Recursion rules: divide
For each of the following problems, what is the smaller problem on which you recurse?
   a) Count the number of people between you and the left wall of the classroom, including yourself

   b) downup

   c) Draw a tree

   d) Sum the numbers in a list

   e) Reverse the characters in a string --- e.g., "COLGATE" becomes "ETAGLOC"
5) Recursion rules:
   ● For each problem, how do you combine the simple piece and the result of the recursive call?
     a) Count the number of people between you and the left wall of the classroom, including yourself

     b) Sum the numbers in a list

     c) Reverse the characters in a string --- e.g., "COLGATE" becomes "ETAGLOC"