CSC148 - Writing Recursive Functions

To review, here is the basic recursive design recipe, which you got lots of practice on in this week's prep:

```
def f(obj: Union[int, List]) -> ...:
    if isinstance(obj, int):
        ...
    else:
        ...
        for sublist in obj:
            ... f(sublist) ...
```

On this worksheet, we'll look at two variation of this pattern, both based on what happens when the function we're implementing takes additional parameters beyond just a single nested list.

Here are the steps you should take, adapted from the *Design Recipe for recursive functions* from the readings:

1. Write at least one doctest for a base case (when `obj` is a single integer), and then implement the base case directly.
2. Write a doctest for the function call on an input of some complexity (e.g., a nested list of depth 3).

   At the side of the page (or on scrap paper), write down the relevant recursive calls (for each sub-nested-list of your input), and what each call would return based on the function's docstring.

   Note: think carefully about the extra parameter for each function; should it stay the same between recursive calls, or should it change somehow?
3. Use your work in the previous step to implement the recursive case in your function body.

DO THIS

1. ```
   def nested_list_contains(obj: Union[int, List], item: int) -> bool:
       """Return whether the given item appears in <obj>.

       Note that if <obj> is an integer, this function checks whether
       <item> is equal to <obj>.

       SPACE FOR DOCTESTS BELOW

       """
       # Your code goes here!
   ```

item: 3

obj: [1, [22], [2, [3,4]]]

nested_list_contains(1, 3) → F

nested_list_contains([22], 3) → F

nested_list_contains([2,[3,4]], 3)

↳ T
   ```

2. Recall from the readings that we defined the *depth* of a nested list as the maximum number of times a list is nested within another one in the nested list. Analogously, we can define the *depth of an object in a nested list* to be the number of nested lists enclosing the object. For example, in the list `[10, [[20]], [30, 40]]`, the depth of `10` is 1, the depth of `20` is 3, and the depths of `30` and `40` are 2. On the other hand, for a nested list that is a single integer, e.g. 100, the depth of 100 in this nested list is 0.

   Implement the function below by following the same steps as before. However, keep in mind here that when we recurse, the `d` that we pass in needs to change—how?

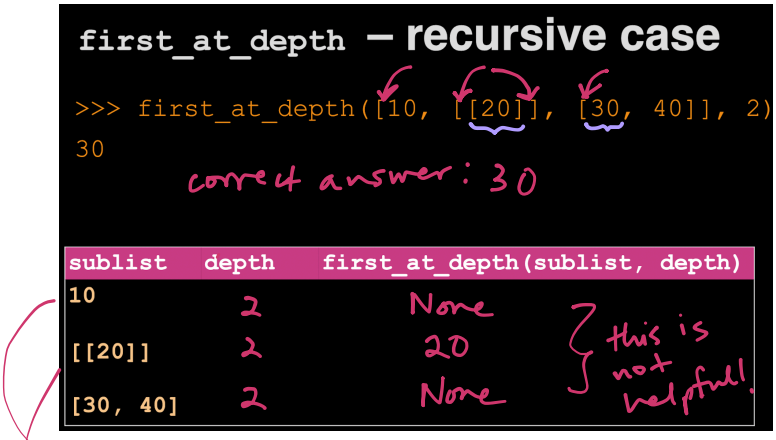
```
def first_at_depth(obj: Union[int, List], d: int) -> Optional[int]:
    """Return the first (leftmost) item in <obj> at depth <d>.

    Return None if there is no item at depth <d>.

    Precondition: d >= 0.

    SPACE FOR DOCTESTS BELOW

    """
    # Your code goes here!
```



first_at_depth(10, 2)

([[20]], 2)

Let's try the above with depth 1:

sublist	depth	result
10		None
[[20]]		None
[30, 40]		30 ✓ this is good

with the recursive call, we must decrease the depth by 1

What's decreasing in the recursive step?
- depth - size of the list