CS 152 Data Structures

Recursive Functions Worksheet

Name: _____

Background

Recursive functions are functions that call themselves to solve a problem. A recursive function typically has:

- A **base case** that stops the recursion.
- A **recursive case** that reduces the problem and calls the function again.

Understanding recursive functions is a key skill for solving problems like traversing trees, generating permutations, and many others.

Part 1: Predicting Output

Problem 1. What does the following function return when called with `mystery(4)`?

```
def mystery(n):
    if n == 0:
        return 1
    else:
        return n * mystery(n - 1)
```

Problem 2. What does the following function return when called with `countdown(3)`?

```
def countdown(n):
    if n == 0:
        return "Liftoff!"
    else:
        return str(n) + " " + countdown(n - 1)
```

Part 2: Convert to Iteration

Rewrite the `mystery` function from Problem 1 using a `while` loop instead of recursion.

Your Solution Below:

Part 3: Recursive Function Practice

Write a recursive function called `next_prime_after_double(n)` that takes an integer `n`, doubles it, and returns the next prime number that is greater than the doubled value.

Steps:

- Write a helper function `is_prime(num)` to check if a number is prime.
- Double the input `n`.
- Recursively find the next prime number greater than `2 * n`.

Algorithm for `is_prime(num)`:

- Any number less than 2 is not prime.
- A number is prime if it has no divisors other than 1 and itself.
- To check this efficiently, try dividing the number by all integers from 2 up to the square root of the number.
- If any of these divisions results in a remainder of 0, the number is not prime.

Optional: Try writing an iterative version of the same function.

Part 4: Reflection

In your own words, reflect on the usefulness of recursive functions. When are they helpful, and when might they be harder to work with than loops?

Prompt: What did you learn about recursion from this worksheet? When might you prefer a recursive solution over an iterative one, and what are some possible downsides?

End of Worksheet