1. Solve the following recurrence on nonnegative integers by guess-and-check and verify your solution by substituting it into the definition of $T$:

$$T(n) = \begin{cases} 
T(n-1) + 2n + 999 & \text{if } n > 0 \\
0 & \text{otherwise}
\end{cases}$$

2. Use the Master Theorem to determine the asymptotic time complexity of an algorithm whose runtime is given by the following recurrence:

$$T(n) = \begin{cases} 
T\left(\frac{n}{3}\right) + n^2 & \text{if } n > 2 \\
1 & \text{otherwise}
\end{cases}$$

3. Consider the following recursive algorithm for summing a nonempty list:

```
function sum(A, i = 0, l = |A|)
    Input: A, a nonempty list of numbers
    Input: i, a nonnegative integer
    Input: l, a positive integer
    if l = 1 then
        return A[i]
    end
    return sum(A, i, ⌈l/2⌉) + sum(A, i + ⌈l/2⌉, ⌊l/2⌋)
end
```

a. What is $n$, the size of the input for this algorithm?
b. What is the basic operation in this pseudocode?
c. What is the recurrence for this algorithm’s worst-case time complexity?
d. What is this algorithm’s worst-case asymptotic time complexity?
4. Consider the following recursive algorithm to raise a number to a power:

Input: $b$, a number
Input: $d$, a positive integer
Output: $b^d$

```plaintext
function power(b, d)
  if $d = 0$ then
    return 1
  end

  let $p \leftarrow power(b, \lfloor d/2 \rfloor)$
  if $d \% 2 = 0$ then
    return $p \cdot p$
  end

  return $p \cdot p \cdot b$
end
```

a. What is $n$, the size of the input for this algorithm?
b. What is the basic operation in this pseudocode?
c. What is the recurrence for this algorithm’s worst-case time complexity?
d. What is this algorithm’s worst-case asymptotic time complexity?

5. Consider the following pseudocode:

```plaintext
function mystery(A, b, c)
  Input: $A$, a list of numbers
  Input: $b$, an integer
  Input: $c$, a number
  if $b \geq 1$ then
    let $x \leftarrow mystery(A, b - 1, c)$
    let $y \leftarrow mystery(A, b - 1, c - 1)$
    let $z \leftarrow mystery(A, b - 1, c - 2)$
    return $c \cdot A[b - 1] \cdot x + y + z$
  end

  return $c$
end
```

a. What is $n$, the size of the input for this algorithm?
b. What is the basic operation in this pseudocode?
c. What is the recurrence for this algorithm’s worst-case time complexity?
d. What is this algorithm’s worst-case asymptotic time complexity?