

Multiply Strings

This problem is requiring manual multiplication without converting to integer (to handle large numbers).

Key Idea:

Grade School Multiplication:

1. Multiply each digit of num_1 by each digit of num_2 .
2. Store intermediate results in an array `product` of size $m+n$ (max possible length)
3. Handle carry while populating the array
4. Convert the array to string and remove leading zeros.

Steps:

1. Per every iteration: multiply $num_1[i] * num_2[j]$.
2. Add product to `product[i+j+1]` (lowest position for that digit)
3. Carry handling:
 $product[i+j+1] += \text{digit product}$
 $product[i+j] += product[i+j+1] / 10$
 $product[i+j+1] \% = 10$
4. Skip leading zeros when converting to string.

Complexity:

- Time: $O(m \times n)$ - nested loops for multiplication
- Space: $O(m+n)$ - for result array.