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// APCS2 PD1
// HW03 -- Speaking in Pseudocode
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THREE WAYS:

1) sum of n numbers = n(n+1)/2
   sum of numbers in array is totaled through a loop of the array, containing one duplicate and missing one number
   sum of n numbers = sum of numbers in array - duplicate + missing

   product of n numbers = n!
   product of numbers in array is totaled through a loop of the array, multiplying by one extra number and missing one
   n! = product of numbers in array * missing / duplicate

   find both equations in terms of duplicate, set equal and cancel out to get:
   missing number = n!(sum of array - sum of n numbers)/(product of numbers in array - n!)

   In the method, use a for loop to update the product of numbers in array and sum of numbers in array. Then use those numbers and plug into equation to return the missing number.

2) sum of squares of n numbers = sum of squares of numbers in the array + (missing number)^2 - (duplicate)^2
   difference = sum of numbers in array - sum of n numbers
   duplicate = (difference + missing number)

   plug the equation for duplicate into the first equation and cancel to get:
   (-(squares of n numbers - sum of squares of numbers in array) - (difference)^2)/(2 * difference)

3) **ONLY WORKS FOR ARRAYS IN ASCENDING ORDER (DUPLICATES ARE NEXT TO EACH OTHER)
   Finding the duplicate number:
   - Loop through the array using a for loop:
     - At each index, see if the value at the index, where the index is the absolute value of the value at the index, is >= 0. If it is, then negate that ENTIRE value.
       If it isn't >= 0, then you know that the duplicate number if the absolute value of the value at that index.

For example:
arr = [1, 2, 2, 4]
int = 0;
arr[Math.abs(arr[0])] >= 0 → TRUE b/c arr[1] is 2
THEN → arr[1] becomes -2

arr = [1, -2, 2, 4]
int = 1;
arr[Math.abs(arr[1])] >= 0 → TRUE b/c arr[2] is 2
THEN → arr[2] becomes -2

arr = [1, -2, -2, 4]
int = 2;
arr[Math.abs(arr[2])] >= 0 → FALSE b/c arr[2] is -2
THEN → the duplicate number is found, which is
Math.abs(arr[2]) which is **2**

Finding the missing number:

Sum of 1 to *n* minus the difference between the sum of the integers in the array currently and the duplicate number