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**Part 1:**

Step 1

1. The observed reliability is 90.94%.
2. The execution time of the brute force implementation is 27.209ms.

Step 2

1. The observed reliability is 72.55%.
2. The execution time of the brute force implementation is 0.0203ms.

Step 3

1. Using a Recovery Block of these two implementations, from above we know the reliability of SubsetSum is 90.94%, the reliability of SubsetSumDP is 72.55%, the theoretical reliability is:



1. If having SubsetSum go first, we know the approximate execution time of SubsetSum is 28.5289ms and the execution time of SubsetSumDP is 0.0203ms, so :



1. If having SubsetSumDP go first , the approximate executing time is:



Step 4

1. From Step3, we know the Recovery Block should start with SubsetSumDP module,
2. The reliability of Recovery Block is 94.91%
3. The Execution time of Recovery Block is 1.532ms

Step 5

1. For Retry Block, if a module does not work, it tries again with a different representation of the data with the same implementation of the module. So for brute force solution, likelihood of failure F = (1 – 0.9094) = 0.0906, in order to achieve 95% reliability, the times of execution N should satisfied:



So the choose N = 2, and the approximate theoretical execution time should be:



1. If using the dynamic programming solution, likelihood of failure F = (1 – 0.7255) = 0.2745, in order to achieve 95% reliability, the times of execution N should satisfied:



So the choose N = 3, with T = 0.0203ms, the approximate theoretical execution time should be:



Step 6

1. Form step 5, we know using SubsetSumDP to implement Retry Block is more efficient.
2. For the transformation function, I wrote a Fisher–Yates shuffle function which time complexity is o(n). I do not shuffle the original array directly, but shuffle the index array instead (e.g. {0, 1, 2, 3, 4} -> {3, 2, 1, 0, 4}). Then use the new index array to generate new input. Once result is generated, because the current index array contains the mapping information to the original index array, so we can use index array together with result Boolean array to reconstruct the output in time complexity is o(n) .
3. The reliability of Recovery Block is 91.23%
4. The Execution time of Recovery Block is 0.0281ms