

Mathematics for Computing

Anagrams as Permutations

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Permutations

How many anagrams (permutations of the letters) are there of the following words

1. ANSWER
2. PERMUTE
3. ANAGRAM
4. LITTLE

Permutations

Part 1 : ANSWER

Examples:

ASNWRE, SANERW, REWSAN, ...

Since ANSWER has 6 distinct letters, the number of permutations (anagrams) is

$$6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = \mathbf{720}$$

Part 2 : PERMUTE

- ▶ The word PERMUTE has 7 letters, but only 6 different letters.
- ▶ There are $7!$ ways to arrange 7 letters.
- ▶ However, interchanging the two Es does not result in a new permutation. There would be two identical anagrams.

PERMUTE, MUTEPE, PETEMUR, ..
PERMUTE, MUTEPE, PETEMUR, ..

Part 2 : PERMUTE

- ▶ The number of permutations (anagrams) is half of $7!$.

$$\frac{7!}{2} = \frac{5040}{2} = \mathbf{2520}$$

Part 3 : ANAGRAM

- ▶ The word ANAGRAM has 7 letters, but there are three As.
- ▶ From before, there are $7!$ ways to arrange 7 letters.
- ▶ How many new permutations are found by re-arranging the As?

ANAGRAM ANAGRAM ANAGRAM
ANAGRAM ANAGRAM ANAGRAM

Part 3 : ANAGRAM

- ▶ We divide $7!$ by $3!$ to account for the identical anagrams.

$$\frac{7!}{3!} = \frac{5040}{6} = \mathbf{840}$$

Part 2 : PERMUTE

- ▶ We re-express the answer from part 2 as follows:

$$\frac{7!}{2!} = \frac{5040}{2} = \mathbf{2520}$$

Part 4 : LITTLE

- ▶ The word LITTLE has 6 letters, but there are two Ls and two Ts.
- ▶ From before, there are $6!$ ways to arrange 6 letters.
- ▶ Again, interchanging the two Ls and Ts does not result in a new permutation.

$$\frac{6!}{2! \times 2!} = \frac{720}{4} = \mathbf{180}$$