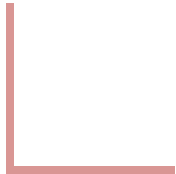


Mathematical Foundations for Computer Applications

Permutations

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Permutations

- The concept of permutation is used for the **arrangement of objects** in a specific order i.e. whenever the **order is important**, permutation is used.
- The total number of permutations on a set of n distinct objects is given by $n!$ and is denoted as

$${}^n P_n = n!$$

- The total number of permutations on a set of n objects taken r at a time is given by ${}^n P_r = n! / (n-r)!$

(Non repeating r elements)

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Permutations-Example

If 6 letters are given , How many 3 letter words can be formed without repetition of the letter?

$$=6 *5 *4 =120 \text{ (by product Rule)}$$

OR

$${}^n P_r = n! / (n-r)!$$

Here $n=6$, $r=3$

$$=6! / (6-3)! = 6! / 3!$$

$$= 6*5*4$$

$$=120$$

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Permutations-Example

If repetition is allowed --Possible arrangement is n^r

Eg--If 6 letters are given , How many 3 letter words can be formed with repetition of the letter?

$$\begin{aligned}n^r &= 6^3 \\&= 6 * 6 * 6 \\&= 216\end{aligned}$$

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Permutations

- A permutation is an ordered arrangement of the elements of some set S
 - Let $S = \{a, b, c\}$
 - c, b, a is a permutation of S
 - b, c, a is a *different* permutation of S
- An r -permutation is an ordered arrangement of r elements of the set
 - $A\spadesuit, 5\heartsuit, 7\clubsuit, 10\spadesuit, K\spadesuit$ is a 5-permutation of the set of cards
- The notation for the number of r -permutations: $P(n, r)$

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Permutations

$$P(n, r) = n(n-1)(n-2)\dots(n-r+1)$$

- If n and r are integers with $0 \leq r \leq n$,

then $P(n, r) = \frac{n!}{(n-r)!}$

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Permutation formula proof

- There are n ways to choose the first element
 - $n-1$ ways to choose the second ($n-2+1$)
 - $n-2$ ways to choose the third ($n-3+1$)
 - ...
 - $n-r+1$ ways to choose the r^{th} element
- By the product rule, that gives us:
$$p(n,r) = n(n-1)(n-2)\dots(n-r+1)$$

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Permutation formula proof

$$p(n,r) = n(n-1)(n-2)\dots(n-r+1)$$

- Multiply and divide by $(n-r)(n-r-1)(n-r-2)\dots 3.2.1 = (n-r)!$

$$p(n,r) = n(n-1)(n-2)\dots(n-r+1) \cdot (n-r)(n-r-1)(n-r-2)\dots 3.2.1 / (n-r)(n-r-1)(n-r-2)\dots 3.2.1$$

Therefore, **$p(n,r) = n! / (n-r)!$**

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Permutations-Problems

1. Determine the number of 4 digit decimal number that contain no repeated digit.

First Digit: The first digit of a four-digit number cannot be 0. Therefore, there are 9 possible choices for the first digit (from 1 to 9).

Second Digit: There are 9 remaining choices for the second digit (from the 10 available digits, excluding the one used). **Third Digit:** 8 , **Fourth Digit:** 7 remaining choices.

$$\text{Total Number} = 9 * 9 * 8 * 7 = 4536$$

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Permutations-Problems

1. Determine the number of 4 digit decimal number that contain no repeated digit.

Total Number = $9 \times 9 \times 8 \times 7 = 4536$

OR

Required number = Total 4 digit number – “4” digit number “0” in the beginning

$$= {}^{10}P_4 - {}^9P_3$$

$$= 5040 - 504$$

$$= \mathbf{4536}$$



THANK YOU

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