Mathematical Foundations for Computer Applications

Unit 2: Counting Principles

Dr. Premalatha H M

Department of Computer Applications

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PRODUCT RULE

Dr. Premalatha H M

Department of Computer Applications

Counting principles

- Two basic counting principles, the **product rule** and the **sum rule**

PRODUCT RULE - Suppose that a procedure can be broken down into a sequence of two tasks. If there are n_1 ways to do the first task and there are n_2 ways to do the second task, then there are $\boldsymbol{n_1 n_2}$ ways to do the procedure.

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THE PRODUCT RULE

- Example: There are **6** flavours of ice-cream, and **3** different cones.
- That means **6×3=18** different single-scoop ice-creams you could order.

Problems

1. The chairs of an auditorium are to be labelled with an uppercase English letter followed by a positive integer not exceeding 100. What is the largest number of chairs that can be labelled differently?

- ***Solution:*** The procedure of labelling a chair consists of two tasks, namely, assigning to the seat one of the 26 uppercase English letters, and then assigning to it one of the 100 possible integers.

Problems

- The product rule shows that there are $26 \cdot 100 = 2600$ different ways that a chair can be labelled.
- Therefore, the largest number of chairs that can be labelled differently is **2600.**

2. There are 32 microcomputers in a computer centre. Each microcomputer has 24 ports. How many different ports to a microcomputer in the centre are there?

$32 \cdot 24 = 768$ ports

Problems

3. How many different bit strings of length seven are there?

- *Solution:* Each of the seven bits can be chosen in two ways, because each bit is either 0 or 1.
- Therefore, the product rule shows there are a total of $\mathbf{2^7 = 128}$ different bit strings of length seven.

Problems

4. How many different three-letter initials can people have?

One has 26 choices for the first initial,

26 for the second, and 26 for the third.

Therefore, there are $\mathbf{26^3}$ possible three-letter initials.

Problems

5. How many different license plates can be made if each plate contains a sequence of three uppercase English letters followed by three digits ?

By the product rule there are a total of

$=26 \cdot 26 \cdot 26 \cdot 10 \cdot 10 \cdot 10$

$= 17{,}576{,}000$ possible license plates.

Problems

6. Suppose statement labels in a programming language can be either a single letter or a letter followed by a digit. Find the number of possible labels.

Use the product rule. $\mathbf{26 + 26 \cdot 10 = 286}$

THANK YOU

Dr. Premalatha H M
Department of Computer Applications

Premalatha.hm@pes.edu

+91 80 26721983 Extn 224