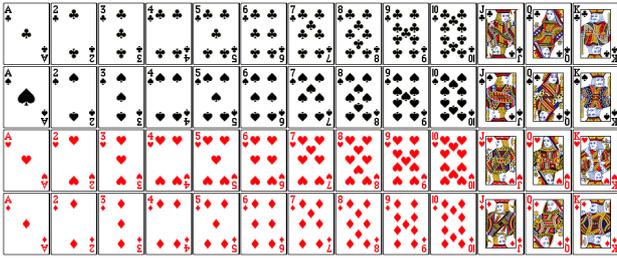


12.2 Fundamental Counting Principle



1

THE FUNDAMENTAL COUNTING PRINCIPLE (FCP) If we want to perform a series of tasks and the first task can be done in a ways, the second can be done in b ways, the third can be done in c ways, and so on, then all the tasks can be done in $a \times b \times c \times \dots$ ways.

2

At an Ice Cream shop they have 5 different flavors of ice cream and you can pick one of 4 toppings.

How many choices do you have?

3

At an Ice Cream shop they have 5 different flavors of ice cream and you can pick one of 4 toppings.

How many choices do you have?

5 choices of flavors,
4 choices of toppings

$$5 \times 4 = 20$$

4

How many ways can you flip 4 coins?

5

How many ways can you flip 4 coins?

The 1st coin can be flipped 2 ways.
The 2nd coin can be flipped 2 ways.
The 3rd coin can be flipped 2 ways.
The 4th coin can be flipped 2 ways.

$$2 \times 2 \times 2 \times 2 = 16 \text{ ways.}$$

four tasks—each done in two ways

6

Someone wants to know how many different outfits they can make with 3 coats, 5 pants, 7 shirts, and 4 ties.

How many different outfits?

7

Someone wants to know how many different outfits they can make with 3 coats, 5 pants, 7 shirts, and 4 ties.

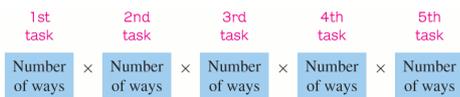
Task	Number of Ways to Perform Task
Select coat	3
Select pants	5
Select shirt	7
Select tie	4

$$3 \times 5 \times 7 \times 4 = 420 \text{ outfits}$$

number of coats . . . times number of pants . . . times number of shirts . . . times number of ties

8

A useful way to keep track of the different number of ways to do each task is called a **slot diagram**.



We'll use underscores for the slots.

9

Example:

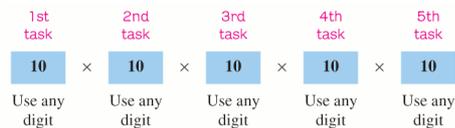
The combination for a keypad is 5 digits long. Suppose that you any digit (0-9) for the numbers.

How many different combinations are there?

10

Example:

The combination for a keypad is 5 digits long. Suppose that you any digit (0-9) for the numbers.



There are $10 \times 10 \times 10 \times 10 \times 10 = 100000$ combinations.

12

Example:

The combination for a keypad is 5 digits long. Suppose that you any digit (0-9) for the numbers. Now, the first digit cannot be 0.

How many different combinations are there?

Example:

The combination for a keypad is 5 digits long. Suppose that you can use any digit (0-9) for the numbers. Now the first digit cannot be 0.



There are $9 \times 10 \times 10 \times 10 \times 10 = 90000$ combinations.

Example: A license plate has 3 letters followed by three numbers.

How many different license plates are there?

14

Example: A license plate has 3 letters followed by three numbers.

How many different license plates are there?

$$\underline{26} \times \underline{26} \times \underline{26} \times \underline{10} \times \underline{10} \times \underline{10}$$
$$= 17,576,000$$

15

Example: A license plate has 3 letters followed by three numbers. Every letter and number must now be unique.

How many different license plates are there?

16

Example: A license plate has 3 letters followed by three numbers. Every letter and number must now be unique.

How many different license plates are there?

$$\underline{26} \times \underline{25} \times \underline{24} \times \underline{10} \times \underline{9} \times \underline{8}$$
$$= 11,232,000$$

17