

# Combinations - Lab

## Introduction

Now, let's dive into combinations. In the previous lab, you saw how the order was important when using permutations. Cracking a code is one example, but what if the order doesn't matter, for example, when an engaged couple wants to pick 3 wedding cakes from a list of 15? You'll need to use another technique here, and this is where combinations come in handy!

## Objectives

You will be able to:

- Decide whether or not permutations and combinations are required for a given problem
- Use Python to calculate combinations and permutations

## Let's get started

From the previous lab, you remember that we created a factorial function.

Now, let's use this factorial function to create a function `combination` as well as `permutation`, both holding 2 arguments `n` and `k`.

```
In [2]: def factorial(n):  
        prod = 1  
        while n >= 1:  
            prod = prod * n  
            n = n - 1  
        return prod
```

```
In [3]: def permutation(n,k):  
        permut = factorial(n)/factorial(n-k)  
        return permut
```

```
In [4]: def combination(n,k):  
        comb = factorial(n)/(factorial(n-k)*factorial(k))  
        return comb
```

Great! We can use these functions in the following exercises.

## Permutations or Combinations?

Flatiron School is holding a mini mathematics contest and there are 9 people in the last round.

**a. Imagine flatiron school is giving out bronze, silver, and gold medal respectively. How many possible ways are there to create this top three?**

```
In [5]: medal_top_3 = permutation(9, 3)
medal_top_3 # 504.0
```

Out[5]: 504.0

**b. Imagine Flatiron school granting the first three contestants a massive fruit basket. How many ways of selecting three people are there in this case?**

```
In [6]: scholarship_top_3 = combination(9,3)
scholarship_top_3 # 84.0
```

Out[6]: 84.0

## Some More Practice using Combinations

Imagine you have 6 different consonants and 4 different vowels written on pieces of paper in a bag. You'll draw 5 letters out of the bag.

**a. What is the probability that you draw exactly 2 consonants and 3 vowels when drawing 5 letters?**

Write the code for getting total number of ways of drawing 2 out of 6 and 3 out of 4 below

```
In [7]: draw_cons = combination(6,2)
draw_vow = combination(4,3)
```

The total number of ways to draw 5 letters out of 10 letters.

```
In [8]: sample = combination(10,5)
```

The probability of drawing 2 consonants and 3 vowels when drawing 5 letters:

```
In [9]: (draw_cons*draw_vow)/sample # 0.23809523809523808
```

Out[9]: 0.23809523809523808

**b. Out of 6 consonants and 4 vowels, how many words with 2 consonants and 3 vowels can be formed?**

You can reuse a part of the previous exercise. Which part? print the result below.

```
In [10]: draw_cons = combination(6,2)
draw_vow = combination(4,3)
```

Now we need to take into account that order is important.

```
In [11]: order_5_letters = factorial(5)
```

The total number of words with 2 consonants and 3 vowels then equals:

```
In [12]: total_words = draw_cons*draw_vow*order_5_letters
print("In total,", total_words, "words with 2 consonants and 3 vowels can be for
# In total, 7200.0 words with 2 consonants and 3 vowels can be formed from our ex
```

In total, 7200.0 words with 2 consonants and 3 vowels can be formed from our existing letter pool.

## Combinations: Creating Soccer Teams

We're holding a mini soccer tournament and 16 people are participating. We'd like to form 4 teams of 4. How many ways are there to do this?

```
In [13]: # your code here # the answer is 63063000.0
first_team = combination(16,4)
second_team = combination(12,4)
third_team = combination(8,4)
fourth_team = combination(4,4)
total_comb =(first_team *second_team *third_team* fourth_team)
total_comb
```

Out[13]: 63063000.0

## Summary

In this lab, you got some practice with combinations, and deciding whether or not combinations and permutations are required for a problem. Congrats! Combinations and permutations are the cornerstones of combinatorics, and you now know how to use Python to compute them in various settings.