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1 Combinations - Lab

1.1 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!

1.2 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

1.3 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`.

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

```
[4]: def permutation(n,k):  
    return factorial(n) / factorial(n - k)
```

```
[5]: def combination(n,k):  
    return permutation(n,k) / factorial(k)
```

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

1.4 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?

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

```
[6]: 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?

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

```
[7]: 84.0
```

1.5 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

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

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

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

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

```
[10]: draw_cons * draw_vow / sample # 0.23809523809523808
```

```
[10]: 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.

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

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

```
[12]: order_5_letters = factorial(5)
```

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

```
[13]: total_words = combination(6,2) * combination(4,3) * factorial(5)
print("In total,", total_words, "words with 2 consonants and 3 vowels can be_
↳formed from our existing letter pool.")
# In total, 7200.0 words with 2 consonants and 3 vowels can be formed from our_
↳existing letter pool.
```

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

1.6 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?

```
[16]: # your code here # the answer is 63063000.0
team_1 = combination(16,4)
team_2 = combination(12,4)
team_3 = combination(8,4)
team_4 = combination(4,4)

total_combination = team_1 * team_2 * team_3 * team_4
total_combination
```

```
[16]: 63063000.0
```

1.7 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.